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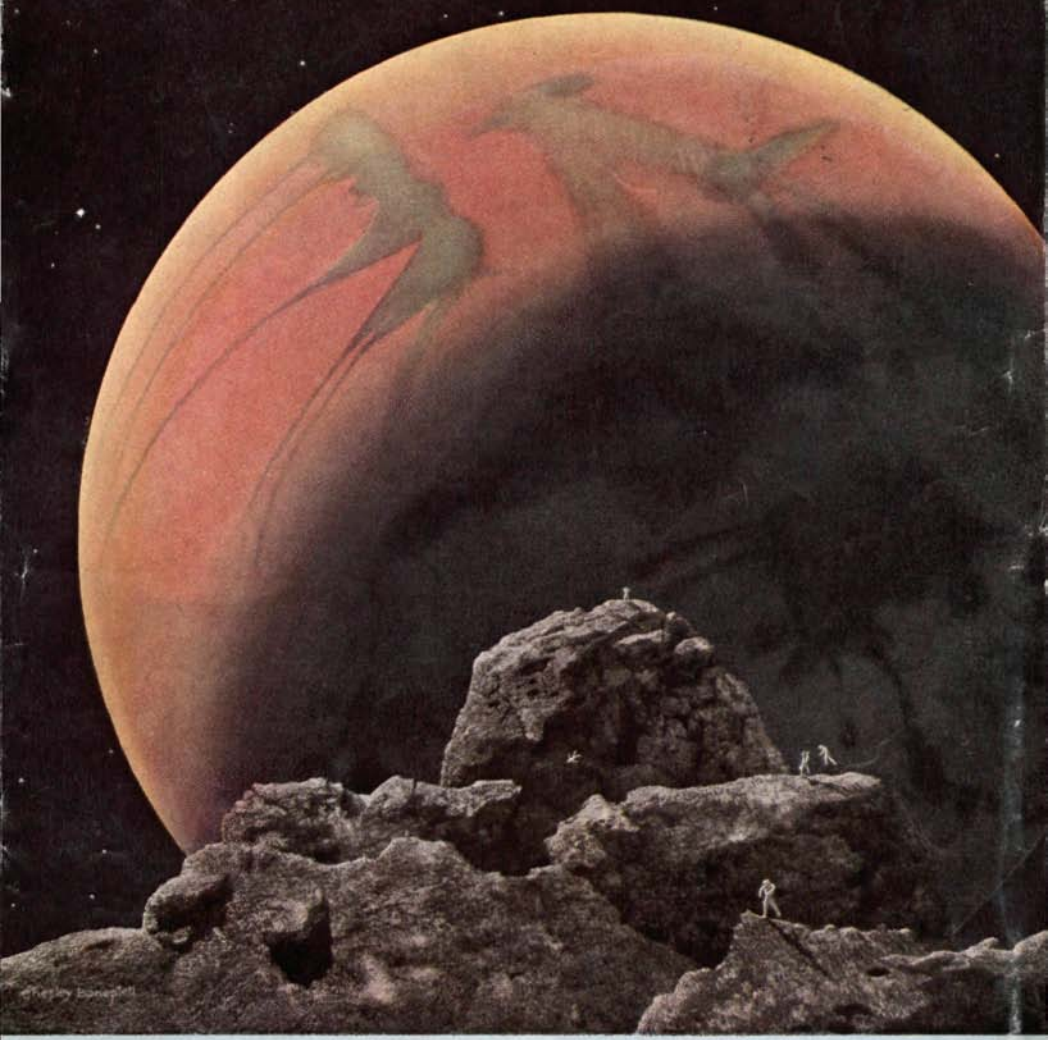

Mars seen from Phobos

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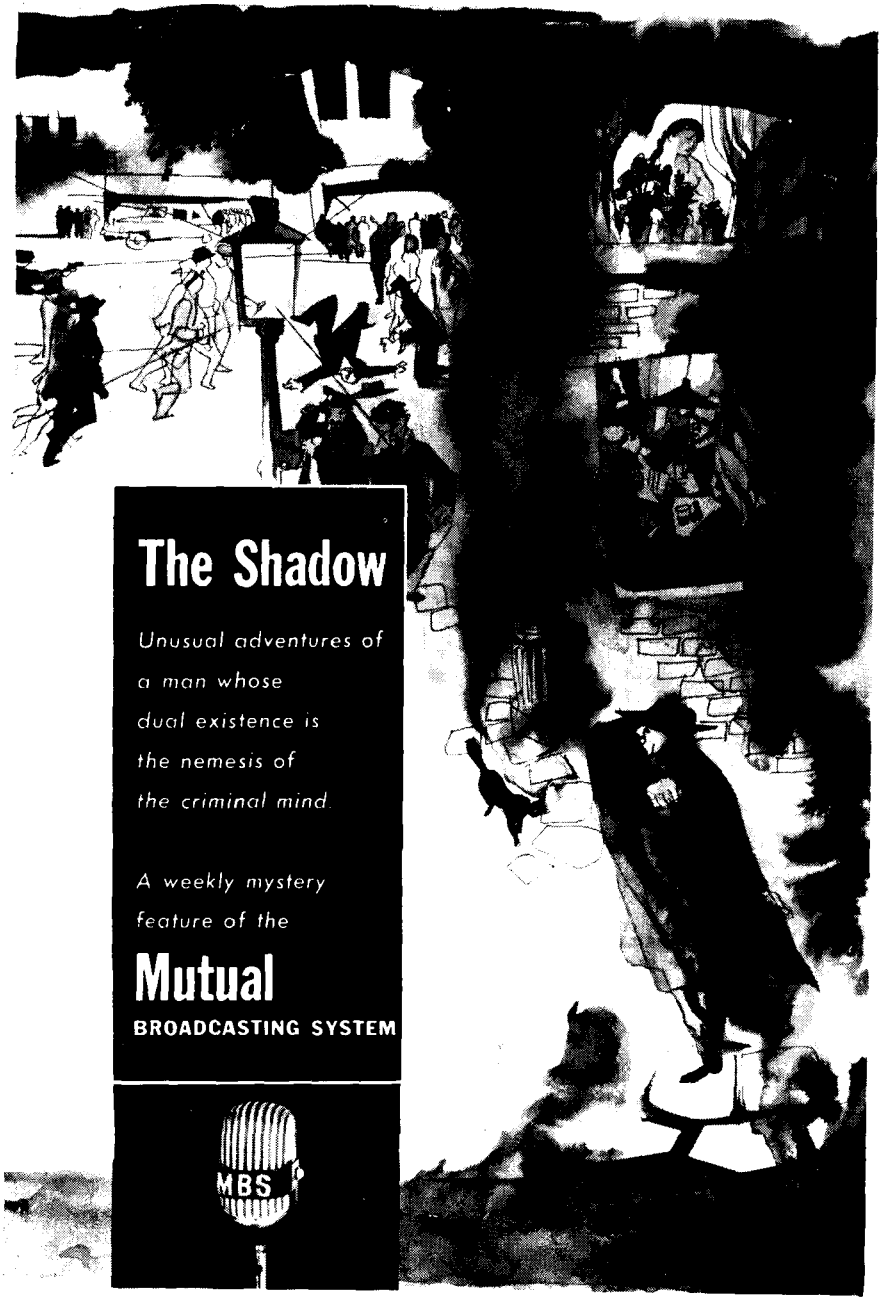

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Astounding
SCIENCE FICTION

VOLUME LIV • NUMBER 4 **December 1954**

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COVER BY BONESTELL • Illustrations by Freas and van Dongen

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$3.50 per Year in U.S.A. *Printed in the U.S.A.* *35 cents per Copy*

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EDITORIAL

"AS A GENERAL RULE..."

Given a problem that has to be solved, there are two things that can be done with it; you can *handle* it, or you can *solve* it. There's an essential difference, and both approaches have their very valid applications. Medicine, for example, can *handle* diabetes, by supplying insulin — but it cannot *solve* the problem. The patient still has diabetes. A fuse can *handle* the problem of a short circuit; it blows out. But that doesn't *solve* the problem.

This doesn't imply that insulin-for-diabetics is something we should scorn, or throw away as useless — it simply suggests that *handling* a problem is supplying a useful crutch, but that living with crutches isn't the ideal approach to the problems of life.

Currently, Statistics is being accepted as a solution to a large group of problems, and efforts to go beyond the statistical method are rather discouraged as unnecessary, futile, or even improper. Quantum mechanics deals with the statistics of particle behavior; the social sciences concentrate on the statistical analysis.

The worst example, in my own opinion, is the social science attitude that not only are statistics useful, but that *only statistical methods* are proper. Statistics, however, can only handle problems; they can never solve any problem.

There are two basic types of generalizations; the statistical generalization, and what we must call the "intuitive generalization." The latter employs a method that no man has ever yet succeeded in defining or describing; because the process is not communicable, and hence not teachable, it is "unscientific."

Trying to define what "unscientific" means is something of a problem; I suggest a useful definition would be: "A process which cannot be taught to a definable group of the population is not scientific." You can't teach a

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totally deaf person to appreciate sound; this is understandable. But, if you say: "If a person reacts to stimuli of *this* defined characteristic, then I can teach him my process." You can't teach a moron certain subtle processes involving high-order abstractions.

But no one has ever been able to define the process of intuition, nor has anyone been able to teach it to a defined group of the population. Every human being resents being rejected in any testing situation — but when he's rejected for no definable reason, he's not merely hurt and unhappy, he's exceedingly wroth. His natural tendency is to accuse the rejector of pointless prejudice, to say there was no test, and the whole business is mysticism.

So — intuition is a process that can't be defined; it yields, however, a type of generalization distinctly different from the statistical generalization.

A statistical generalization is produced by a logical-mathematical technique, which can be defined and taught, and one which is predictably accurate. The generalization so obtained is valid for groups of the same nature as that studied; it induces a generalization from individual instances, but the generalization *does not* apply to any individual instance.

The result is that insurance companies, nations, and social groups can use statistical generalizations, but individuals can not. It's a method of reasoning from the particulars to the general that does *not* permit deducing particulars again.

The intuitive generalization is typified by the Natural Law type of generalization. It is induced — somehow — from individual instances, and the generalization so induced, unlike a statistical generalization, is characteristically capable of permitting the deduction of individual instances. Newton's Law of Gravity, for example, was induced from observations of local falling bodies, and the motions of the Moon. From it, individual planetary behavior can be deduced.

Statistical methods can be used to *check* a natural law, or an intuitive generalization; they *can not yield* a natural-law type of generalization.

Statistical methods are of immense importance and utility; the great danger is that the group using the statistical method may, as the social scientists tend to, hold that no other method is desirable or proper. The psychologist does just fine with statistical correlations; the psychotherapist, however, has to deal with an individual human being, and statistics don't help him at all. It's like the insurance company actuary who can question a man on his age, occupation, age at death of his ancestors, and predict: "You have 22.7 years to live." But the individual's doctor can't come in, find him in bed, and make the same prediction. If the doctor did, it's per-

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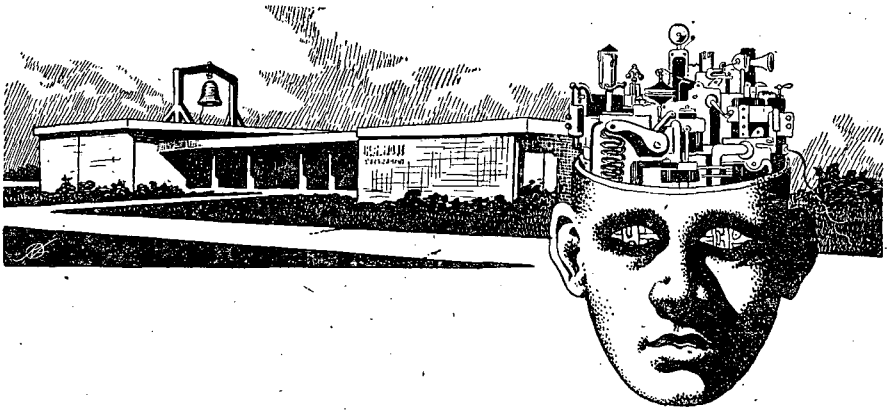

THE SCHOOL

BY RAYMOND F. JONES

One of the great problems has always been, "Who can teach the best and most advanced experts?" The answer's easy . . . but a method of making it work? For how can a man teach himself?

Illustrated by Freas

The instrument house at the edge of the runway was crowded with the high brass and top-drawer engineering staff of Firestone Aviation Corporation. They peered over one another's shoulders and jockeyed politely for better views of the three-foot television screen at one end of the room. It showed the interior of the pilots' compartment of the XB-91 now flying somewhere above them at an altitude of fifty thousand feet.

In the front row of observers Major Eugene Montgomery watched with a feeling of elation inside him. The Ninety-one seemed almost as much a personal triumph for him as it was for the engineers who built it. He had witnessed its building from scratch and some part of him was up there flying with it.

The Ninety-one was the first genu-

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ine battleship of the air. It was a city-smasher, capable of going to any spot on the globe and doing its work. Its armament assured a better than ninety per cent chance of destroying all opposition and returning safely.

The instrument panel occupied most of the picture. Now and then there was a glimpse of the side of test pilot Parker's face. Out of sight, on the other side, was co-pilot Marble.

Parker's voice came over the speaker. "Turning now to retrace course. Altitude fifty-two thousand, air speed eighteen seventy-five, temperature minus forty-eight point seven —" He spoke in a professional monotone that failed, however, to hide his enthusiasm for the ship, too.

A score of small sounds filled the room. The whir of cameras recording the picture and voice from the plane, the background whine of the ship's jets, the click of telemetering relays. Abruptly, Montgomery turned to find his close friend and the man most responsible for the success of the Ninety-one. He spotted Soren Gunderson at the very back of the group.

The chief engineer of Firestone Aviation wasn't even looking at the screen. He couldn't, Montgomery saw as he came up. There were too many heads in front of him.

Gunderson sat on the edge of a desk drawing hard on a pipe cupped in his right hand.

"It looks like you've really got it made," said Montgomery. "This is better than anything we dared hope for!"

Gunderson nodded without expression. Parker's voice came on again. "Entering course—autopilot on—throttles maximum—"

The faint beep of the electronic timer signaled the passage of the XB-91 through the first of the radar marker beams. Seconds later, another beep sounded the completion of the ten-mile run. The men in the room waited in silent attention as the timer operator checked his instruments—all except Soren Gunderson. He seemed scarcely interested in what was going on in the room as he sucked meditatively on the pipe.

"Twenty-three eighty-five point seven eight two," the timer technician announced.

A restrained murmur arose from the executives, engineers, and Air Force men as they turned to each other with pleased smiles. Jacobs, President of Firestone, came back to Gunderson and shook his hand. "It's a wonderful ship, Soren," he said. "I'm sure that now we can forget about that other little matter—"

"On the contrary," said Gunderson. "This is the time. Make my resignation effective as of the moment the Ninety-one is accepted."

Jacobs' face clouded. "I hope you don't mean that. Come up to my office after lunch and we'll see if we can't thresh out something."

"Sure," said Gunderson. "I'll come up."

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The group cleared rapidly from the room to watch the landing of the plane. Gunderson and Montgomery remained alone.

"What's this talk about a resignation?" the major asked. "You're leaving Firestone and going somewhere else?"

Gunderson stood up and nodded. "Yes, I'm going—somewhere else."

"I can imagine you've had plenty of offers, but I would have thought Jacobs would top any of them to keep you on, especially after the success of the Ninety-one."

Gunderson grunted and looked through the window to the runways. The plane was not yet in sight, but the group of engineers and brass were standing immobile, awaiting it. Gunderson smiled faintly. The plane makers didn't often allow themselves to be awed by their own creations, but this was one time they could not help it.

The engineer turned back to Montgomery. "Two hundred and eighty-five tons, sixteen engines, three quarters of a mile per second—and it'll do even better when they check it out at seventy thousand, where it belongs. The biggest and the fastest—all in one ship. The Air Age makes progress, Monty!"

Montgomery's eyes narrowed at the bitter smile on Gunderson's face. He was used to his friend's sudden inversions, but this was more unexpected than usual. "What's wrong, Soren?" he said. "Is there something about the Ninety-one you haven't told us?"

Gunderson was a rather small man of forty-eight. His hair was beginning to gray on the sides. As he sat hunched on the stool now, drawing on his pipe, he looked almost wizened.

"There's only one thing wrong with the Ninety-one," he said at last. "It's a failure."

"Failure—!" Montgomery's face went white as he thought of his own position among the Air Force experts preparing to accept the ship. "What are you talking about? It's—"

Gunderson's head nodded rhythmically. "The biggest, the fastest, the heaviest, the most monstrous—It's the final spawning of a long line of monsters. And, unless we've lost our senses completely, it'll be the monstrosity to end all monstrosities."

Montgomery relaxed. With the tension of the work now safely past him, Gunderson was feeling free to ride one of his hobbies again. The major wasn't sure just what this would turn out to be, but he prepared to listen sympathetically.

Gunderson saw the change in his face and understood what he was thinking. "You're going to believe every word the picture magazines say about our beautiful Ninety-one, aren't you?" he said.

A thin, high whine began to fill the air as the ship soared overhead, still high, maneuvering for an approach to the other end of the field.

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"They'll give it a two-page spread," Gunderson went on. "The Ninety-one in the middle—around it little pictures showing it generates as much power as thirty railroad engines, enough heat to warm a town of fifteen hundred people, has enough wiring to take care of the town's power and telephone system, more radio tubes than—"

"And the citizens will lean back and sigh: Progress!"

The whine grew to a thundering roar that drowned their voices. The mammoth landing gear smashed against the earth as Parker eased the bomber down. It rolled at a crazy speed, fighting the drag of wing flaps and brakes. Its thunder shook the walls of the instrument house and the hangars and the distant plant.

Then it was still. Parker was smiling broadly and shaking hands with himself behind the windshield. The red tractor began rolling out on the field.

There seemed to be pain on Gunderson's face. "You ugly devil!" he murmured to the gleaming ship. He swung around to Montgomery. "Let's get out of here!"

Major Montgomery was Liaison Officer between the Research and Development Command of the Air Force and the Firestone Aviation Corporation. He thought he had come to know Soren Gunderson as well as he knew the XB-91, but the chief engineer's reaction to the successful test flights of the ship certainly made him feel more than a little uncomfortable.

They drove a half mile from the plant and settled behind a secluded table in George's Spaghetti House, where a good many past conferences between them had ironed out discrepancies between hard engineering fact and the specifications of the Air Force. Montgomery watched his friend out of the corner of his eye and decided to keep his mouth pretty much shut—except for such prodding as might be necessary to find out what was eating Gunderson.

George took their orders and went away. Montgomery laced his fingers back and forth and smiled. "Everyone knows that modern combat requirements have put the size and cost of aircraft almost completely out of hand," he said carefully. "But it looks to me like pretty substantial progress that we have been able to meet those requirements at all. Even five years ago the Ninety-one wasn't considered an actual possibility. Your new wing section is the only thing—"

"A monster with a gutful of electronic equipment," said Gunderson, "duplicated and re-duplicated to make sure a ten-cent resistor doesn't bring the downfall of a hundred million dollar airplane."

He brought his gaze back to Montgomery's face and smiled. "I'm sorry, Monty. I guess you've never heard me go on quite like that, have you? I usually do it alone—in the middle of the night.

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"But you know I'm right. Every competent engineer in the aircraft industry knows it. Our manufacturing methods just aren't good enough—and can't be made good enough—to eliminate the duplication of components. Our design should be capable of creating a plane to perform the military function of the Ninety-one in a tenth its size and weight—and cost.

"What price tag will the production model have? We can guess at eighteen to twenty million. It's economically disasterous to put that much into a single piece of equipment as vulnerable as a plane—even one with the dubious importance of being designed as carrier for the H and cobalt bombs. As a solution to an engineering problem, it's a bust."

"Why didn't you build the Ninety-one a tenth its present size, then?" said Montgomery cautiously.

George appeared with their orders. Gunderson unfolded the napkin and tapped the side of his head. "Here—," he said. "We haven't got what it takes up here."

"You have no right to blame yourself! With your accomplishments—"

"Not just me," said Gunderson. "All of us. Your R&D outfit, NACA, the universities, the airplane plants. Look how we operate: We spend a couple million for a new computer, six million for a wind tunnel, our reports cover miles of microfilm. R&D farms out a million or so projects all over the country.

"But do you remember the story about how the Wrights learned to warp a wing? Just the two of them, watching the shape of a little cardboard box Wilbur twisted about as they talked—and there it was.

"How many of your people are capable of catching such a tiny clue? Not the R&D supervisor who's wondering how to jack up his GS rating from 12 to 13, or the wind tunnel chief, or the computerman. Something's wrong with the way we're going about it. We've built giant data-collecting organizations under the fond delusion that this was research. We build oceans of little ingenious gadgets, thinking this is invention. And we look in vain in all this mass of data and gadgetry for the new, basic idea. It isn't there. So we build another flying monster and pat ourselves on the back."

Montgomery contemplated the long string of spaghetti dangling from his fork. "I've heard some of that kind of talk before," he said. "I always thought it was just the product of a bad week when everything had gone wrong. If it's actually true, what can be done about it? What are *you* going to do about it?"

"That's the question I've been asking myself since we started the Ninety-one on paper, a dozen years ago. I've been asking it all my life in one form or another. I don't have any answer, right now, but I'll never build another

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airplane unless I find it."

"But what are you going to *do*?" Montgomery insisted.

"I've saved my money," said Gunderson. "I'll do a little fishing, maybe quite a lot. And I think I may go to school."

Montgomery's hand seemed to remain suspended in midair for a small fraction of time. His eyes shot a glance of startled amazement toward Gunderson, and then he bent over the plate of spaghetti. "For a minute I thought you said you were going back to school," he said with a laugh.

"There's no law against a man getting some more education."

"No, of course not—except that you could walk into any engineering school in the country and make their aeronautic staff look like hicks. I don't get it. Who could teach *you* anything about plane design?"

Montgomery allowed himself to watch Gunderson more closely now as the engineer replied somewhat absently. "This isn't an ordinary school I'm talking about. I started hearing stories concerning it about six months ago. Norcross, from Lockheed, was the first to mention it. He wrote that he'd quit his job and was doing some advanced study at this place. I thought he was crazy. Then I began hearing from some of the others, all inviting me down to join them."

"What are they doing? Who runs the school? I never heard of anything like that."

"That's the peculiar part. I've asked, but they act almost cagey about details of what they're doing. Yet they're all overwhelmingly enthusiastic about it. A couple of men named Nagle and Berkeley are operating it privately. You may remember they got quite a bit of publicity a year or so ago because of a large rumpus they stirred up in regard to the patent situation. It was enough to get a Congressional investigation and it looks like there'll be changes in the Patent Law."

"I remember," said Montgomery. "R&D people didn't think much of their antics."

Gunderson smiled. "I don't imagine they would!"

"I know Norcross," said Montgomery. "He's very good. I can't imagine any kind of school that could teach him or you anything at all about aircraft engineering."

"Neither can I. But I want to find out. I've reached a dead end. The whole industry has. The engineers know it and continue to whistle in the dark, hoping for some miracle to pull them out of the hole—atomic engines small enough to go in a fighter ship, at a price mot more than twice that of a jet—some way to reduce the fantastic spread of components we have to jam in—

"There won't be any miracle. There'll have to be a change in the basic kind of thinking we're doing. Less of the six million dollar wind

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tunnel brand, and more of the little cardboard box variety!"

Montgomery returned to the plant with Gunderson, in a state of excitement he tried not to show. But it was tinged with regret, too, because he and Gunderson had become very good friends during the time of building the mammoth bomber. He left the engineer at the entrance to the giant hangar where the Ninety-one had been pulled in for postflight checking. He hurried to his own office on the ground floor of the plant administration building and closed the door, locking it carefully.

Then he sat down at his desk and put in a call to his Washington superior, Colonel Dodge. It took twenty minutes to locate the colonel, but at last Montgomery heard his distant, rough voice.

"I have some information," said Montgomery. "It would be best to scramble."

"All right. Code twelve," said Dodge.

Montgomery pressed a sequence of switches on the little box through which the phone wire ran. His voice thinned out as he spoke again. "It's that matter you told me to be on the lookout for six months ago. It's finally happened here. Soren Gunderson is resigning. He says he's going back to school."

"Not Gunderson, too!" said Dodge bitterly. "It's an epidemic. To date, almost two hundred men have resigned from highest priority military projects—all giving the excuse of wanting to attend this mysterious school. It has bogged down over thirty big projects, because they weren't just run-of-the-mill engineers. They were chief engineers and project engineers and top designers. The whole military program of the nation has been slowed measurably by this draining away of key personnel.

"I'm telling you this to emphasize the absolute necessity of finding out what is going on and putting a stop to it."

"Do you want me to follow through on it?"

"Just a moment." There was a click of circuit switching and the colonel's voice came back. "I've put Dr. Spindem on the line. As head of the Psychological Service Section of R&D, he's been consulted on this problem. I want him to talk to you."

Montgomery frowned distastefully. He remembered Spindem as a big man with a bluff, jovial front which he forgot to change outside of office consultations.

"Hello?" said Spindem. "It's good to talk with you again, major."

"Yes," said Montgomery.

"I understand you are personally well acquainted with this man, Gunderson."

"We've been very close friends for almost four years."

"Well, what we're after now is to get one of our men into this so-called school. We've held off any action

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against them so far, hoping for a chance like this. You're our first real opportunity. Do you suppose you could get an admission to the place through Gunderson?"

"I don't know. Admission seems to be by very select invitation. It goes only to the very best men in the field, apparently. My own qualifications in this regard—"

"You'll have to do whatever you can, major. This is important. Do your utmost to utilize Gunderson's friendship to get you admitted to the school for a personal inspection. We've been able to find exactly nothing so far. It appears, on the surface, to be one of the most cleverly designed sabotage schemes ever encountered. It seems to have an unshakable hold on the minds of those attracted to it—and they are minds essential to the nation's military preparedness."

"Consider those your orders," Colonel Dodge said. "We'll have another man ready to move into Firestone when you leave. And I want a daily telephone report of your progress."

Colonel Dodge heard the distant click of Montgomery's phone, but not of Spindem's. He breathed heavily in resignation. "Why couldn't it have been *anybody* else besides that blockhead, Montgomery? We've been waiting six months to put a man there—and *he* turns out to be the first possibility."

"It's not very hopeful," Dr. Spindem agreed. "But it may turn out better than you think. In the meantime, we'd better keep our eyes open for another chance."

II.

Montgomery replaced the phone and folded his hands on the desk. His eyes stared ahead, seeing nothing for a moment. This new assignment was nothing to cheer about, but he was glad he had been able to remain at Firestone throughout the construction of the Ninety-one. His contribution was not exactly visible, yet it was substantial. He knew he'd done a good job of expediting the flow of information back and forth between the Air Force and the engineers.

One thing he appreciated in the change, however, was the chance he might have to help Soren Gunderson if the engineer were going to be sucked into some foolish program that would injure himself and the nation's production. But he wondered if he actually had any chance at all of getting inside this school. It didn't seem likely that operators of the kind they appeared to be would give the Air Force a chance to come in and snoop around.

He left the office and went back to the testing area. Gunderson was busy in conference with the group of XB-91 engineers, analyzing the data of the morning's flight. So Montgomery spent an hour roaming through the ship, drinking in again the sense of

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power and greatness of the giant plane. He had been aboard during some of the earlier check flights, but he had never had a chance to take the controls himself. Now he went up to the pilots' compartment and sat down, wondering if he ever would get a chance to handle it. That was the one thing he still deeply desired.

The XB-91 was representative of the new concept of bombing planes, the invincible, self-contained fortress of the air. It flew alone, high, and twice as fast as sound. The approach of any object during flight, interceptor plane or guided missile, triggered the Ninety-one's defenses. Automatically, at such approach, the bomber spit out its own target-seeking missile to destroy any attacking device at a safe range. It wasn't vulnerable, as Gunderson said, Montgomery thought. It was the most completely invincible machine ever devised.

But something of what Gunderson had said that morning continued to nag at Montgomery as he moved along the catwalk, inspecting the empty nests that would hold the target-seeking missiles. It was true there was a kind of vulnerability built right into the ship—the vulnerability of its nightmare complexity. It would be nice to have simpler answers to complex problems, but where were they going to be found? If men like Gunderson couldn't devise them, who could?

The chief engineer was alone in the hangar office when Montgomery came down from the plane. He waved a hand through the glass partition and walked into the room without knocking.

"The Ninety-one doesn't look as if the speed runs shook her to pieces," he said.

Gunderson was looking half-pleased with the sheaf of papers under his hands. "No, we discovered one small area of vibration near the tail that's not good. But I think we can clear it up with just a little modification of the frame at that point."

Montgomery sat down. "Something's been bothering me. I can't get out of my head the business you were talking about this morning. This school thing—"

Gunderson nodded. "I've found it pretty hard to keep off my mind, too."

"I've been wondering—just suppose the thing does turn out to be on the level, that they've really got something there—do you think there's any chance you might be able to get me in?"

Gunderson looked at the major in surprise. "I didn't think you would be interested in anything like that."

Montgomery smiled easily. "I suppose I've been a soldier long enough to acquire something of that Army Look; but actually I'm perfectly aware of the truth of the things you said this morning about the unmanageable complexity of the Ninety-one. If this school has got something that will draw men like Norcross and you, I

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think I'd like to get a piece of it for myself."

"I don't know. I haven't made application yet. Could you get away?"

"Dodge has been pretty decent since I've been in R&D. I think he'd go for it, if I asked him."

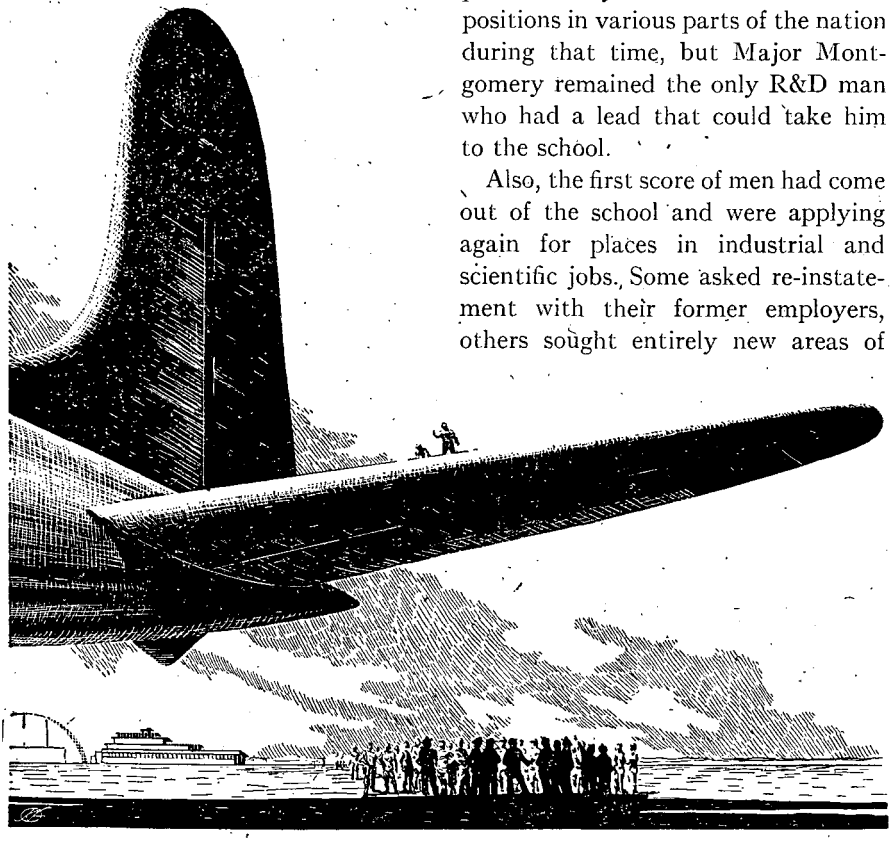
"I'll do what I can," said Gunderson. "But remember, it's still a pig in a poke as far as I know anything about it."

"I'll gamble with you on it," said Montgomery.

Six weeks later, modifications were completed and the Ninety-one was accepted by the Government. Almost simultaneously, Soren Gunderson's application was accepted by the Nagle-Berkeley Institute, and he was invited to bring his associate, Major Montgomery, for interview.

Colonel Dodge chafed daily on the phone regarding the inaction during that period, and did everything he could to speed up the acceptance of the plane. Thirty other men left critical positions in various parts of the nation during that time, but Major Montgomery remained the only R&D man who had a lead that could take him to the school.

Also, the first score of men had come out of the school and were applying again for places in industrial and scientific jobs. Some asked re-instatement with their former employers, others sought entirely new areas of



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activity. None would make any comment regarding his absence.

Official word had gone out quietly, however, that until more was learned of the school the applications of these men were to be held in abeyance. They were not to be hired even as janitors in critical plants. On the other hand, it was desired to avoid any investigation that would appear as a frontal attack and scare off the operators of the school prematurely. Dodge managed to convince *his* superiors and the FBI that Montgomery offered their best opportunity.

The Institute was located in the small northern California town of Casa Buena, on the coast near the Oregon border. Montgomery drove from Seattle alone, following Gunderson and his family by a day. It had been decided that Montgomery's wife, Helen, and their two children would remain where they were since this might be a quite temporary assignment.

The major checked in at one of the two resort hotels as soon as he arrived in Casa Buena. His next act was arrangement of the phone scrambler and a report to Dodge—and to Dr. Spindem, who listened in on most of his conversations. This fact inspired a persistent irritation like that of an irremovable splinter in the hand.

It was midafternoon, but when he finally called Gunderson he was told to hurry over. Their initial interviews could be taken care of at once.

The school was at the edge of town on a low bluff overlooking the ocean. It occupied a set of old California-Spanish style structures that once housed an unsuccessful summer resort. Heavy foliage screened it from the road. The interior court had been landscaped to a Mediterranean garden —with only a slight touch of Hollywood. It formed a kind of "campus" on which numerous students lounged in the shade as Montgomery and Gunderson walked toward the administration building. Montgomery could not help staring as he recognized at a distance the features of men whose brains literally controlled large segments of the aircraft industry.

In the office, a secretary took their names and announced their presence over the interphone.

"Dr. Berkeley will see you, Mr. Gunderson," she said, "and Dr. Nagle will see Major Montgomery."

Montgomery felt a spasm of apprehension. The success of his whole operation here depended on the next few minutes. He managed to grin back at Gunderson as the engineer held up a circled forefinger and thumb. Then he was gone.

A door opened to Montgomery's left and the girl ushered him into the presence of a pleasantly sharp-eyed man in his middle forties. "Dr. Nagle," said the girl, "this is Major Montgomery."

"Come in, major," said Dr. Nagle. "We already know something of your background, and it was indeed a pleas-

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ure to receive your application."

They sat on opposite sides of a large, mahogany desk and surveyed each other a moment. "One of the first things we like to know," said Dr. Nagle, "is why a man chose to apply for admission to the Institute in the first place."

Montgomery's face sobered. He paused a long moment, both for the hoped-for effect of impressing Nagle—and to collect his own full quota of reassurance. He had rehearsed this to himself for the last six weeks. Now to see if he could put it over.

"As you may know," he said, "Soren Gunderson and I have worked closely together during the past four years in building the XB-91." As Nagle nodded, Montgomery went on. He borrowed as closely as he dared the bitter objections Gunderson had made to the Ninety-one. He modified and embellished, adding items of his own, all the while watching carefully the reactions of Nagle's expression.

"Soren and I have felt there ought to be some answer to this inadequacy of our engineering. When he began hearing about the Institute, I was immediately interested also in the possibility that some solution had been found. Of course, I was frankly dubious," he said with a smile. "You can't expect a man not to be—but I decided I wanted to find out for myself."

Nagle's expression changed but little during Montgomery's story. As the engineer finished, he said, "Did you do anything during the building of the plane to try to eliminate some of these troublesome complexities?"

"Well, yes—during the time the wings were in design I felt there ought to be another answer to the tremendous demand for lift at the ship's service altitude. It was just a fuzzy sense that there ought to be some other way of building it. I worked out a few sketches on my own, but nothing came of it."

Nagle remained silent, watching him as if speculating over the truth of his statements. "Gunderson calls his plane a monster—a failure," he said finally. "And he's right. From an engineering standpoint the thing is quite ridiculous. It's the end product of our 'bigger and better' creed, which has been our standard for some time. Bigger planes, bigger automobiles, bigger plants—laboratories—schools—houses. You know how it works in your organization. A supervisor rates a grade higher when his personnel reaches thirty in number, so he phonies up enough projects and recruits the additional men. For every honest administrator there are a dozen empire builders working their pet researches into the status of major projects—with them at the head."

Montgomery started to protest involuntarily. "R&D isn't—"

Nagle cut him short. "The problem has been with us for a long time, but

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only in the last decade has it been felt as severely as it is right now. Our need for creative engineering and design has been more intense than ever before, and we have increased our efforts to obtain it proportionately. The result has been to greatly magnify all the obstacles which have always stood in our way.

"We have become aware that we are in the midst of a famine of genuine, new basic ideas. The XB-91 is a monument to this famine. It was built from the mountains of data we have collected, but it is not the product of invention and research."

"The nation has done everything possible to foster technological growth," said Montgomery. "Our engineering schools have never operated at the peak they now are."

Nagle smiled slowly as if enjoying a joke briefly at the major's expense. "You are quite right. More schools and more engineers than ever before. Yet the problems represented by the XB-91 are not being solved by the kind of thinking coming out of our engineering schools today."

"Why not? Do you consider the schools themselves responsible?"

"Actually—no, the schools are not responsible. There are scores of factors, but standing well out in front is our misevaluation of what public education is supposed to accomplish."

"Certainly, one of its major aims is to produce an adequate corps of creative engineers!"

Nagle shook his head. "No. But in order to understand the failure of any mechanism it is best to inquire if the mechanism was designed to perform the failed function in the first place.

"The school is a peculiar institution. Even its personnel are regarded as public property. The control imposed by a community upon its schoolteachers has long been a stock source of humor, but there's nothing funny in it to anyone who's ever experimented with making the school anything but the strict, literal voice of the community.

"Educational systems have always been a source of public pride, whether in Rome of the fourteenth century, or Paris, or London, or Podunk Corners, U. S. A. New advances in education are announced with great fanfare. In reality, however, the school never changes. Its basic purpose today is the same as it was when Egyptian boys studied the Book of the Dead to learn how departed souls must act to obtain happiness.

"It existed in the ancient synagogues, the military barracks of Sparta, the gymnasiums of Athens, the harsh discipline of Roman schools. It was in the church schools and universities of the Middle Ages, as well as in Napoleonic France where the system was geared to reverence for the new emperor, 'given by God.' It's painful to attempt an evaluation of our own current system, but the basic purpose is there.

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"In all ages the educational system has existed to enable the individual to become an integral part of his cultural life—whatever form that culture might have."

"That doesn't sound extremely ominous," said Montgomery.

"I haven't said that it is. Judgment on that point will be left up to you. But let us consider the system in engineering terms:

"A culture demands a certain minimum degree of stability for its existence. Uniformity of customs, thoughts, and habits contributes to this stability. Likewise, there is demanded a heavy checkrein on excursions too far away from the cultural norm. Both of these items, the uniformity and the restraint, can be very adequately provided by indoctrination in the Traditions of the Elders, by dispensing All That is Known of the Universe and Man in the sixteenth century, or by wrapping up the results of much data collection in a Handbook of Wing Design for aeronautical engineers.

"This represents a homeostatic process. The school is the instrument designed to carry it out. It's the thermostat on the stove to keep the pot from boiling over."

"If that were true, the school would be responsible for keeping things as they are—not for venturing into the new and unknown!"

"Exactly," said Nagle. "An educational system forms a homeostatic control over the natural adventuresomeness of the individual human mind to keep it in line with established patterns. It preserves the cultural ideal at all costs through widespread indoctrination with the particular mass of data currently accepted as 'truth.' *This is its only function.*"

"I should think that would be extremely difficult to prove."

"On the contrary, it is so obvious it requires nothing more than calling attention to it. It is more than amply demonstrated by the fact that no educational system has ever been able to concern itself with the basic object of its ministrations: the *individual* human brain. The enormous range of variation in human minds has been taken into account only as something to be flattened out so that whatever curriculum is in vogue can be injected with minimum effort. No effective program to investigate these variations and harness their usefulness has ever been established. Earnest people have thought upon the problem from time to time, but they seemed unaware that the educational system is basically unable to do anything but what it is doing."

"This sounds rather rough on the educators."

"Not at all! They're fulfilling the function assigned by society long ago when the first half dozen families gathered outside the communal cave and decided little Joe Neanderthal

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was getting too big for his britches and somebody was going to have to teach him a thing or two. They've been teaching him ever since this first school was set up. There are many social homeostats outside the family now, but the school was the first—and the function of a homeostat is to flatten variations."

Montgomery laughed. "I suppose everyone has that kind of feeling about his education at times—although I'm not yet convinced your description is wholly accurate. I do remember seeing at one time, however, a picture of an ingenious machine to stamp walnuts with a brand name. Regardless of the shape or size of the nut it came through the machine with the same brand as all the rest. I thought then that schools had also been stamping the nuts with identical brands for a long time."

Nagle smiled broadly and nodded. "They deal in terms of classes, not individuals, of materials to be taught, of obtaining agreement from the pupils, not of inviting them to original thought. We laugh now at little Joe Genius being held down by the backwardness of the Little Red Schoolhouse on the prairie, and exult in his eventual triumph over it. We fail to recognize that the Little Red Schoolhouse is still with us—even though it now has air-conditioning, glass bricks, and cantilevered roofs. We fail to recognize that discovery and invention are culture-smashing activities, and education is a culture-preserving mechanism. By its very nature, then, education cannot sponsor any vital, new departures in any facet of our culture. It can only appear to do so, to preserve the sustaining illusion of progress while at the same time maintaining the homeostasis of the culture."

"And all this leads to what?" said Montgomery.

"To the question of what happens to a working system when the setting of its homeostatic control is pushed down too low!"

Montgomery shifted uncomfortably. He refused to believe the arguments Nagle was proposing, yet he wasn't quite sure how he would have refuted them if he had been in a position to do so.

"I suppose in that case," he said, "the fire goes out. You believe this has happened?"

"It is happening," said Nagle, "at an alarming rate. Education is being substituted for learning. Data-collecting is taking the place of research.

"Perhaps no period of our culture has seen a more optimum balance between the two than the last thirty years of the nineteenth century and the first decade of this one. Education was widespread enough to enable a country the size of the United States to function as a unit—and limited enough to keep from smothering the culture-shaking activities of the

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Edison-Ford-Wright type. We have to work toward a restoration of that balance."

Montgomery shook his head—not too vigorously, in view of the necessity to not antagonize Nagle. "Cultures can't be static structures trying to avoid all change," he said. "They don't last very long if they are. To exist, a culture must be a vigorous, growing entity. Ours is—and in my opinion our educational system is largely responsible for it. For every invention of the Edison, Ford, or Wright type you've got a thousand others produced quietly in industrial and university research centers, and each is just as important in its own way as the work of the barefoot boys who sold newspapers. After all, the atom bomb didn't come out of somebody's basement lab!"

"No—it came only after virtually all homeostatic forces involved were thoroughly shackled. We could argue the variations in thousands of instances, but that would hardly be practical.

"What is practical is to note that the situation we're in produces XB-91's—and will continue to produce them unless a change occurs. We have to tackle the basic problems of the minds that do the thinking. We supply them with bigger wind tunnels, more complex computers. That merely evades the problem. It doesn't solve it.

"We must find out the nature and purposes of the human being—of you and me. We have to turn our vision from the external world to the internal. This is something that science, society—our whole culture from the very beginning—has been afraid to do. We make believe we're going after it by taking electroencephalograms, analyzing blood constituents and glandular products. But this, too, is an evasion. It tells us nothing of what a man *is* and what he's doing—and why he's doing it.

"And you've missed my point about the function of homeostatic controls. They don't necessarily prevent cultural growth. They keep it within certain bounds. But the control must not be confused with the agency responsible for growth. That would be somewhat like confusing the thermostat with the fire!"

Montgomery felt a sense of anger growing within him for a reason he couldn't quite name. Nagle seemed so sure he had all the answers. "What agency is responsible, then?" he demanded.

"That, my friend," said Nagle, "is what you are here to discover for yourself."

"And in spite of all your objections to schools it appears that you have set up still another one."

"Our Institute has been called a school, but it shouldn't be. Our function is primarily to reverse the activities of the ordinary school. You might—and quite correctly—say that we

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are engaged in *de*-educating—"

"*De*-educating—?"

"Yes. Meaning to remove the homeostatic controls imposed by your education—to whatever degree you wish them removed—and from whatever source your education was derived."

"Even if I were to accept the possibility of this, it sounds more than a little dangerous—to both the individual and his society."

Nagle's eyes grew more sober. "I wouldn't have you acquire any illusions on that point. It is capable of very great danger—to both parties!"

III.

As if the interview had already gone somewhat farther than he desired, Dr. Nagle arose from behind the desk. "I'm sure you would be more interested in seeing some of our actual procedures. Suppose we look in on some of the people."

They left the office and went out along the loggia that led past a number of rooms. Montgomery's heartbeat increased at Nagle's apparent implication that there was no question of his acceptance by the Institute. If he did a good job of his assignment here and provided a thorough exposé of the crackpot theories upon which the Institute was evidently founded, he ought to be in line for a promotion.

Dr. Nagle stopped with his hand on a doorknob. "This is our music class. We'll be breaking into the middle of a session, but it will be all right if we don't disturb the performer."

Montgomery started to ask what possible reason there could be for a music class in an Institute supposedly devoted to advanced technology, but he didn't get a chance. A wave of sound burst upon them as Nagle opened the door slowly. Montgomery caught sight of an enormous stage occupied by a symphony orchestra of at least a hundred pieces. Nagle beckoned him forward and closed the door.

There was a feeling of unreality about the place. While the music crashed and sang in torrents of melody, Montgomery stared about. The room facing the stage was tiny, and there were only five men present. Four of these seemed to be concentrating their attention, not on the orchestra, but on the fifth man, whose head nodded and jerked in rhythm with the music.

"Sit down," Nagle whispered.

The back of the sandy-haired fifth man in the group seemed strangely familiar. Montgomery shifted until he got a better side view. Then he inhaled with involuntary sharpness. It was Norcross, the top design engineer who had first interested Gunderson in the Institute. Montgomery wondered why he was the center of interest now. Possibly he was the composer of the symphony? That seemed merely fantastic. Montgomery was certain he possessed no such talent.

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In spite of his tense curiosity the major leaned back and gave himself over to the flowing warmth of the music. He was no critic. He didn't know whether it was good or not. But it *sounded* good. As it picked up tempo to an almost frantic pace, they were joined by Soren Gunderson and Dr. Kenneth Berkeley.

The face of Norcross was filmed with perspiration now. His hands beat time as if he were actually conducting the orchestra himself. Then with a triumphant crash of sound the performance came to an end.

Norcross sank down in his chair, stretching his feet at full length and fanning his face wearily. The four other men gathered round and clapped his shoulder in hearty congratulations.

"Boy, I didn't think I'd ever make it through that last movement!" Norcross exclaimed. "I bit off a little more than I could chew."

Montgomery was scarcely listening. The stage had suddenly gone dark and the orchestra had vanished as if never there at all. And the stage was not enormous, after all. It was no wider than the end of the small room.

Montgomery was still staring as Norcross turned around and spotted Gunderson. He jumped to his feet and rushed forward with extended hand. "Soren! You made it, after all! I didn't think you were ever going to get the lead out and leave that kite factory. How'd you like my music? Believe it or not, six months ago I couldn't play a tin whistle."

Gunderson took his friend's hand warmly. "I'm no musician, but it sounded good to me. I had no idea you went in for composition. And I expected you to be spending all your time with stress analysis and engine-loading figures. How come the music?"

Montgomery interrupted before Norcross could make any answer. A slow, tight feeling was advancing along the skin of his back. "What happened to the orchestra?" he said.

As if he had made a joke, this was a cue for general laughter among all the men of the Institute. Dr. Nagle held up a hand even as he joined in the amusement. "I think we had better enlighten our visitors," he said, "before we have a blown gasket or two."

He gestured toward the stage. "There was no orchestra, of course. What you see is merely a shadow box in which the projections of the student's mind are made visible and audible. You perhaps didn't notice the small headpiece Mr. Norcross was wearing, but through it the impulses of his mental composition were conveyed to the mechanism of the shadow box and made perceptible to everyone in the room."

"You mean you composed the music and imagined the motions of the orchestra as you went along!" Gunderson exclaimed incredulously.

Norcross nodded. "It's tough going at first, but you can learn it. I hope we got a good tape. I want my wife to

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hear it. That's about the best one I've done yet."

Montgomery felt as if the whole situation had become completely unreal. In a moment someone would break down and give the trick away. The shadow box was some kind of movie projection device. It had to be. *Nobody* could be good enough to do what was claimed. Certainly not Martin Norcross, airplane engineer and designer—

But they were beginning to move out of the room and Nagle was speaking again. "If any of you still question the presence of a music department in an engineering school, let me assure you that what you have just seen and heard is a rigorous mental exercise on a par with anything you will ever do in creative science. You can estimate for yourselves the number of factors that must be coördinated and manipulated and kept under absolute control at all times. It is an excellent engineering practice!"

They entered an adjoining room which contained a dozen seats and had one wall that resembled a blackboard except that it was a smooth milky whiteness. At Nagle's bidding, Norcross donned another headset. It was a small, narrow band that clamped a pair of thin electrodes above his ears.

"Show us your next electronic design problem," said Dr. Nagle.

Norcross scanned through some sheets in a notebook. "It's an airborne radar," he said. "Thirty-mile range—"

Almost at once there began to appear on the white wall a schematic diagram. A little shaky at first, it grew in complexity with startling rapidity. Beside the components there appeared electrical or mechanical specifications. In a little less than ten minutes the intricate diagram was completed. Norcross took off the headset. "I think it'll work," he said, "but I wouldn't want to guarantee it!"

"It will work," said Nagle confidently. He turned to the others. "These items are part of Mr. Norcross' graduation program, incidentally. This is the kind of routine all our students go through before they leave."

Montgomery continued to regard the wall with the same sense of unreality that had come upon him in the other room. He touched a finger to its smooth, glassy surface. The markings were on the other side.

"We photograph them for permanent record," said Nagle. "Except when it's a mere practice session which the pupil does not wish to keep. For most of that kind of work, however, we use the small three-dimensional box."

He went to the rear of the room and drew away from the wall a four-foot cube on rollers. He pressed a button at one side and the thing became luminous in the interior.

"Would you care to demonstrate?"

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he suggested to Norcross again.

The latter plugged his headset into the side of the panel at the cube's bottom edge. Almost instantly, a small silver airplane appeared inside the cube. Realistically, jet fire poured from the engine. The plane maneuvered as if in actual flight, diving, climbing, rolling.

"Perhaps you'd like to try it?" Nagle suggested to Gunderson.

Grinning a little nervously, the engineer took the headset from Norcross and adjusted it to his own head. He stared into the now empty interior of the cube. "What do I do?" he said.

"Build a copy of your XB-91 and put it through its paces," Nagle suggested.

Slowly there appeared a fuzzy, highly asymmetrical outline of the Ninety-one. Gunderson laughed uncertainly at his own creation. "Looks more like the ghost ship of the Ancient Mariner. What the devil's the matter with the engines on the right wing? They won't fire up."

"Turn the plane around," Norcross suggested.

Clumsily the model turned on its own axis, the tail disappearing in the process. Gunderson restored it. The engines on the left wing were out now, while the others were going.

"Can't keep it lit up on both sides," he complained. He felt moisture starting out on his forehead in the strain of maintaining the image.

"That's a lot better than most of us do the first crack," said Norcross. "We engineers pride ourselves on our visual ability. This shows us where we really stand."

Gunderson shook his head unhappily and took the headpiece off. He extended it to Montgomery. "Try your luck, Gene. See if you can build a Ninety-one, complete with wings and tail."

Montgomery felt as if something had frozen inside him. He couldn't have taken the headpiece if his life depended on it, he thought later. "No," he said thinly. "I'm going to expose my ignorance in private, first."

There was a great deal more to see and learn, Dr. Nagle told them, but the afternoon had grown late, and they were dismissed with the request to return the following morning. Montgomery felt shaken by what he had seen. And all the way back to the hotel he cursed the schoolboy fright that had kept him from accepting the headpiece of the visualizer cube. He had acted like a bashful kid at a party game and he couldn't understand it. Nagle caught it, however. As if he understood exactly what was going on in Montgomery's mind, he had taken the headpiece and changed the subject before anyone else could say anything. The director had been willing to spare him embarrassment, but it increased Montgomery's irritation that it should have been so obvious to Nagle.

The prospect of making a telephone

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report to Dodge was another source of sharp irritation. He postponed it until after dinner, and then decided the colonel could just as well go without his report.

He took a long walk down to the beach and sat on the rocks until after it grew dark. Then, gradually, as if daring to peek through the crack of a door into some closet of nightmares, he allowed himself to consider what he had seen at the Institute that afternoon. He wanted to dismiss it all as trickery and a hoax, but it wouldn't go away that easily. Norcross appeared perfectly honest in his part of the demonstration. Montgomery couldn't see how he could have been duped after spending as long as he had at the Institute. Nor was there any purpose evident in such duping.

The only reasonable conclusion was that the engineer had been endowed with near-superhuman abilities during his stay. But Montgomery wasn't prepared to accept this kind of answer without a struggle.

When he got back to the hotel a call from Dodge was awaiting him. He wished then that he had done the calling. He would have been better prepared with a story that would sound halfway reasonable. Certainly he couldn't tell the truth over the phone. The colonel would think he'd gone crazy.

But Dodge was mostly interested in whether Montgomery was going to be admitted or not.

"I'm pretty sure they're going to let me in," said the major. "Nagle acted as if there would be no question about it at all."

"Did you get a look at anything to give you an idea what's going on?"

"No. I had a long talk with Nagle. He seems to be off on some kind of a phobia against schools. Apparently, if we burned down the buildings and fired all the teachers and professors everything would be all right, in his opinion."

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The colonel grunted. "That's about the kind of thing Spindem thought we'd find. I've been thinking seriously of assigning him to come out there and work with you closely on this. The thing we need to know is how they manage to suck in the top talent of our military suppliers. They must have quite a trick to do that."

"I'll try to find out, sir, and keep you informed," said Montgomery.

He hung up, hoping he'd be able to nail down the answer before Dodge sent Spindem out. That would be just a little more than he could take, he thought.

The following morning he was introduced to the counselor, Don Wolfe, as soon as he appeared at the Institute. Wolfe was a much younger man than either Nagle or Berkeley, but he shared the same calm assurance that he knew what it was all about. This irked Montgomery, but he hoped he could continue to keep the irritation under control and not get himself thrown out prematurely. He forced himself to listen attentively.

"Dr. Nagle gave me a run-down on the things he discussed with you yesterday," said Wolfe. "Unless you have some questions, we'll go into the matter of how the effects are produced."

"The only question is whether or not I'm being accepted for work here," said Montgomery.

Wolfe smiled. "Evidently Dr. Nagle forgot to mention that you are the one who decides that. We have quite a few people who don't stay with us very long—after they see what I am going to show you today!"

He led the way out of the office and across the court to another building. Inside this, he took Montgomery to a small room which was lined on one side with panels of electronic equipment of some kind. It was decorated pleasantly over soundproof wall board. The furnishings consisted of a couple of chairs and a table and a couch.

Wolfe indicated a chair and gestured toward the panels. "This is the Mirror—sometimes known affectionately among Institute members as Nancy the Nemesis, or Minnie the Monster. At any rate, you'll have some rare moments here if you decide to join us."

"What does it do?" said Montgomery.

"As a mirror should, it offers you a look at yourself."

Montgomery frowned. "That doesn't seem to make very much sense."

"It doesn't at first to most of the people who come here. You've been warned away from it all your life. When you went to school they gave you an I.Q. test and put a label on you, which you were taught never to question. You were stupid, average, or brilliant and there was absolutely nothing you could do about it if your category was lower than you would have liked. Your attention was directed to the exterior world as it was

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described to you. And agreement with that description was demanded. If you saw wiggles where woggles were described, you learned to agree that they were woggles—or you had another tag applied to you: academic failure.

"In view of these discrepancies you were more than willing to agree after a time that it was best not to try to look into this sealed box you wear on top of your spinal column. That is the almost universal attitude we encounter."

"And now I'm invited to take a look into the box, is that it?" Montgomery looked dubiously at the panels of the Mirror. "Minnie, the mechanical psychoanalyst!"

Wolfe smiled: "She's been called that before, too. But that's the one name that's wholly inaccurate from the standpoint of function. The machine does nothing to interpret you to yourself. It doesn't tell you anything or offer advice on how to adapt and get along better in the world. It does absolutely nothing but hold up a reflection for you to observe and make your own conclusions. It has only one control feature built in—and this is quite necessary. The extent of the reflection is governed automatically by your own fear level."

"Fear—!"

"Yes. You will find that in spite of the simplicity of Socrates' admonition it is quite a fearful thing to attempt to know thyself. So instead of taking a full, unobstructed view at first it is necessary to take a knothole view, so to speak. Get a tiny peek at one aspect of yourself and digest that and learn to live with it before broadening the outlook."

"I fail to see why there should be any fear involved in this—as long as a man hasn't committed some crime which he's afraid to face."

"We don't need anything as melodramatic as criminal acts. You'll see. As an indicator, however, you might consider the common, publicly acknowledged fact that Man uses twenty per cent or less of his available brain power. This is regarded quite sadly with clucked tongues about what a shame and a waste it is—but any determined effort to increase this percentage is greeted almost with fury. Psychoanalysis is a fair target for anybody's humor. To ascribe one's deficiencies to cruelties and inadequate care in childhood is to acknowledge ignoble surrender. You'll find it quite curious that there should be such antipathy toward investigating and increasing the powers of the individual. It requires a genuine self-appraisal to be effective. And this is simply too painful. It has to be fought: 'No thanks, I'm not crazy *yet*.' 'There's nothing wrong with *my* brain!'

"There are two main causes for this reaction. The deficiencies of orthodox psychiatry cause it to miss the boat more often than not. It essays to deal with the explosive forces of human esteem—inadequately. The Mirror has

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no such drawbacks. It permits you to ask: Who am I? What am I doing? What do I know? And gives you a source of a perfect, undistorted answer: yourself. This is strong meat, however. A full, reflexive view is loaded with absolute terror. That's why we begin with the knothole picture and expand gradually."

"I still seem to miss the connection between all this and the ability of an engineer to build a better airplane—which was the initial incentive that brought most of us here."

"That won't remain a mystery very long," said Wolfe. "You will examine the ten thousand agreements you have made with your professors and with other engineers that This is the Right Way to Proceed. You 'll examine the ten thousand agreements you've made that your ability is not sufficient to do the job before you. One by one you'll examine each of these tiny homeostats which control your thinking now—and decide whether it's worth keeping. Every derogation of yourself, every acceptance of someone else's solution to a problem without working it through for yourself, is such a homeostat. Some of them you will keep. Most you will throw away, and wonder why you ever saddled yourself with them in the first place!"

It was becoming the most incredible mass of hokum he had ever heard, Montgomery thought. If it were not for the Norcross demonstrations, which still had to be explained, he would have given up now and called for Dodge to come in and take over. He regarded the panels of the Mirror with a degree of fear as Wolfe rose and began manipulating controls there—it was not the kind of fear Wolfe had been talking about, however, it was fear of how far he could go with this mechanical hypnotic-psychoanalytic gadget without risking harm to his own brain. He wished now that he had pushed Dodge's suggestion that Spindem be sent out. As much as he disliked the psychiatrist, he felt his advice would be valuable—and protective!—now.

Wolfe was holding out a small headpiece similar to those Montgomery had already seen. "You can try it out if you like, work with it as long as you care to—or walk out now and forget everything we've told you."

Montgomery's face felt moist. He wished he were free to take the last alternative. He thought of Dodge, and the possible promotion that might come out of his investigation.

"I'll try it," he said. "What do I do?"

"Just put this on and take it easy. You can lie down or sit in the easy-chair. When you are through take off the headpiece and the circuits of the Mirror will shut themselves off automatically."

He helped Montgomery adjust the metal tabs on either side of his skull. The major took the easy-chair and

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leaned back. "Nothing's happening," he said. "Something must be wrong."

Wolfe smiled. "It's working, all right. Come in to the office if you care to when you're through."

He left the room, closing the door softly. Montgomery sat in the chair, swearing to himself—not quite so softly.

How had he ever got sucked into this in the first place?

IV.

He sat tensely for at least five minutes, pressing the tips of his fingers together and waiting for some manifestation from the apparatus. When nothing had occurred at the end of that time he allowed himself to relax a trifle. It appeared he was not going to be overwhelmed with some kind of mechanical hypnosis trying to convince him he was a five-star genius, misunderstood and unsung, anyway. How long should he sit here before going back to the hotel and reporting to Dodge, he wondered.

Of course, if he had it his way, he never would report to Dodge—ever again. Dodge was an administrative windbag who knew virtually nothing whatever of the research processes he was called upon to program and direct. It was more important to him to keep Senator Graham's sixth cousin happy as director of a study that was way over his head than it was to find a way of shrinking the size of the XB-91.

But, then, his own position was not so different. He considered it superior to that of the engineers doing the actual work. In reality, he was little more than an office boy in gold braid—

He sat up sharply. What the devil was going on? What kind of thinking was that? He held an important post—a *very* important post. Without his coördinating efforts the XB-91 wouldn't have been built for another year, at least. Anybody could push a slipstick back and forth, but it took someone who understood the engineering and possessed the administrative qualities—

His thought ceased momentarily in a swirl of confusion. He leaned back in the chair and closed his eyes, clinging to the single concept of his key importance as Liaison Officer over construction of the XB-91. He had to cling to that idea. It was suddenly of overwhelming importance.

And then it was gone. A swirl of panic surged in his belly. He felt as if he were trying to reach out for something lost and forever beyond him. But it was gone, and he glimpsed what was left.

He was not merely Dodge's kind; he was worse. He pretended to be an engineer. Dodge didn't make the pretense.

He had a degree in engineering, but he was no engineer. He never had been. He knew the formulas and he could find things in the handbooks,

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but a new, complex problem that had no handbook solution left him in panic. None of his kind, who spent their time telling the genuine engineers what ought to be done, could do the job themselves if it were turned over to them.

He was as close as he could get. His training had won him a commission and he'd stayed on, ending up in R&D liaison. He had to be proud of it. It was all he'd ever have—

And now he didn't have even that. He'd forced himself never to recognize it before—that he was a fake, a phony, a completely false front hiding an unbearable incompetency. He bent forward, burying his face in his hands, and wept.

The panic subsided and a slow, diffuse anger seeped through him. He looked up at the panels of the Mirror, as if aware for the first time that the machine had something to do with the stabbing recognition that had passed through him.

He felt the pressure of the headpiece against his skull and tore it away with a single motion that hurled it against the panel, shattering a meter face and crushing the headpiece. The anger stayed with him and he wished that he might tear the place down. But Dodge would do it better, he thought with some satisfaction. He and Dodge and Spindem—they'd really rip the place apart when the time came.

He left the room quietly. He saw no one about as he went out of the grounds and across the street to his car. He drove back to the hotel and put in an immediate call to Colonel Dodge. It took only a moment to reach him.

"Montgomery," he said. They selected their scrambler code and he went on. "I got a look at the inside for the first time today. I think Spindem ought to be here."

"Just a moment, I want the doctor to hear this." There was a click and a moment of silence, then Dodge asked him to go on.

"They've got a machine," said Montgomery. "Something dreamed up by one of the original designers for the Inquisition. I had to get away from it. I felt like I was going crazy. I'm willing to bet that plenty of men have graduated from here straight to the nut house."

"But what does it *do*?" Dr. Spindem demanded.

Suddenly Montgomery wished he hadn't called. He felt like he couldn't talk about it any more. His anger was spent. He answered wearily. "I don't know. It just gets hold of your mind and suddenly you're convinced that everything you've ever done has been wrong. There's nothing right about anything."

"Are you going back?" said Colonel Dodge.

"Don't do it!" Spindem exclaimed. "I'll get away sometime tomorrow, but don't do a thing until I get there. Your sanity may depend on it."

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"Don't worry," said Montgomery. "I'm not sticking my head in that noose again for anybody."

He went down to the beach in the afternoon sunshine and there he had the chattering shakes. He threw pebbles at the sea gulls wheeling over the rocks. He stomped up and down on the sand. But he couldn't stop the trembling of his muscles.

So he wasn't really an engineer! So he had always made like a big shot to cover it up! What difference did it make? The work he'd done had been useful.

But it was no good. He slumped down on a rock and let the shaking possess him. He'd kidded himself. That's where the trouble lay. He'd kidded himself—and now he couldn't kid himself any longer. Everything that had supported him was gone. Maybe it was flimsy and phony, but it wasn't right to strip it away like this. Now that it was gone, however, he could never again walk into a conference and hold his head up as if he were the equal of the men on the other side of the table. He never had been their equal, but he had been able to function under the illusion he was their superior. Now, he could no longer function at all.

His hand grasped a weed stalk and drew idly in the sand. A wing section formed, a curiously irregular wing section that would have provoked laughter in any engineering group. But the laws of air flow and lift were not quite the same at eighty to a hundred thousand feet as they were at sea level. His section could have shortened the span of the Ninety-one by twenty per cent. He was sure of it. Why had he never tried to get it tested?

He didn't quite know. He'd told himself it was a wild idea that had no merit. Could the truth be that he had been unwilling to face the possibility of ridicule for his unorthodox engineering venture?

He didn't know the answer to that, either. He only knew that something had been taken from him that enabled him to function, and now he had to have it back, or he'd never be able to function again. He had to see Wolfe and the people at the Institute. It was a sudden obsession with him. They had taken it away; they could give it back.

It was late when he reached the Institute, but Don Wolfe was still in his office. "I rather expected you'd be back today," he said. "You gave us quite a shock when we saw the taped record of your experience with the Mirror this morning. Your fear tolerance level is higher than any we've seen yet. You've got more guts to take an honest look at yourself than anybody who's gone through here up to now. Usually, it takes a week or two to blast out as much as you got in an hour."

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"I imagine I'm supposed to be pleased," said Montgomery sarcastically. "I want back what I had before. I may have been a four-flusher, but at least I got along and did a job. You took away that ability. You've got to give it back!"

Wolfe was shaking his head very slowly and smiling faintly. "There's a fundamental principle inherent in the Mirror," he said. "It holds up an image, but it does not force you to look. You see nothing but what you are willing to see. There is only one answer for you now: go back and look again and ask yourself why you had to be content with the character of a phony big shot instead of being a productive individual in your own right."

Montgomery knew that unaccountably he was going to do it. He must have known the moment he decided to come back. The Mirror was hypnotic—or narcotic—in its effect. He had to come groveling back and see if there was any answer to the question of his inability to be an engineer honestly without the false front of his uniform and R&D assignment.

Don Wolfe accompanied him back to the room. He saw that the damage of his burst of anger had been repaired. Wolfe made no mention of it.

"I'm going to wait for you in my office. Will you come over when you're through?"

Montgomery nodded mechanically, as if in a daze. His hands were trembling faintly as he sat down and put on the headpiece. Like a hophead, he thought. You hate the stuff and can't leave it alone. How can I ever get away from this thing now?

Wolfe observed him for a moment with a slightly worried frown. "I can turn down the fear-level control a bit, if you want me to," he said. "Since your own acceptance point is so high, it might be easier on you—"

Montgomery waved him away. "Leave it alone. I want to know what goes on—I've got to find out."

He settled back and closed his eyes as Wolfe closed the door behind him. A feeling of peace and serenity began to flow through him and he knew he should have stayed that morning without breaking off in anger as he had done. He should have seen it through then.

It was strange, though, that he could regard himself almost happily now, recognizing full well the phoniness that had adorned his entire career. After the initial panicky confusion it seemed almost a relief to feel it being stripped away. It *was* a relief—and now he saw why.

A thousand fears and apprehensions had gone into the support of his false front. Every time he'd gone to an engineering conference there was a constant panic that he would make some absurd break that would bring laughter around his head from the engineers. Half the muscles of his body maintained an agonizing tension in anticipation of it. And he'd prided

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himself on the exhaustion with which he left those meetings! He'd go home and flop on the sofa at the end of the day and tell Helen what a "rough one we had today."

He began laughing, a slow chuckle at first that quickly rose to almost uncontrollable spasms verging on hysteria, as he caught full sight of the ludicrous spectacle he made staggering under the weight of his self-created burden that had no existence for anyone else.

Slowly, the laughter died. And the panic came back. Not as strong as it was the first time, but it was there. He felt helpless and unanchored. It was all right to laugh at himself for behaving like a fool, but that didn't change the fact that he had done the best he could under the circumstances. He *was* incompetent. He could never be an engineer like Soren Gunderson if he admitted he was all the fools who ever lived. Nothing could change the real picture of his inadequacy.

But why? he asked himself. The panic seemed to freeze a little and lose some of its violence as he probed the black screen where the shadows of himself were in hiding. He wasn't a moron. Way back in school they'd tagged him, as Wolfe had said. They gave him an I.Q. test and wired on a label. But it was a good label. It put him way up in the top one per cent of the population as far as intellectual ability went.

In spite of this he'd been a complete bust. Or perhaps because of it? he wondered. He'd once felt sorry for those far below him in the merely average levels. But they were the successful ones now. Somebody had made an extensive study once, he remembered, about high I.Q. failures. He wondered what they found out.

Probably nothing. A man should be able to answer his own questions, but there was no answer in sight as far as he could see. He'd tried to do everything right in school, from the first day to the last. Top honors, all the way through. They'd patted him on the head approvingly, as if he were a pet pup. In the grades there'd been a time when he was shunned as the teacher's favorite.

Homeostatic controls, Dr. Nagle said. What did that mean, anyway? What controls had he agreed to accept during his school days? The concept made no sense—

He gasped in sudden helplessness as if a flood poured down upon him while he sat chained, unable to move. Black waves washed forward, sweeping over him. His body strained upward, as if seeking the air, then he slumped before the flood, babbling and whimpering in terror.

He didn't know how long he lay there. It seemed as if forever, and there was a dark whispering of leaves in his ears and the flashing of bright-edged pages before his eyes. The leaves of the calendar of all the days,

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and the pages of all the books—

But it was utterly insane. School had not been these dark days of terror. It had been warm and friendly. Warm and friendly—while they pinned on his mind each of ten thousand tiny homeostats to see that he never moved out of line. He was the teacher's pet with the I.Q. of a genius.

And for daring to glimpse behind their professional smiles and watch the little machines they attached to his cortex they would shake him with this terror.

He couldn't endure it. He cried out for them to take him back. He wouldn't look again, he promised. He would believe forever that they loved him and he wouldn't tell anyone about the little machines in his mind.

The black waves receded. He sat up, drenched with sweat. Drops of it fell from his chin to his shirt front. He opened his eyes dazedly and glanced up at the panels of the Mirror. I'm going crazy, he thought numbly. The machine is driving me crazy—

Nagle and Berkeley and Wolfe had found out why he was here. That was it. They knew who he was and why Dodge had sent him. He had been a fool to think they would let him in that easy. They had set the machine so that it would make a babbling idiot out of him, and when they got through with him no one would believe anything he said about the Institute. He glared up at the panels. If he could only reach up there and smash something to turn it off. But he couldn't get up. All his strength was gone. Maybe in a minute more—if he could just sit here without thinking.

Dimly, he remembered Wolfe saying all he had to do was remove the headpiece and the machine would shut down. The thought struck him with panic again. He couldn't do that. He had to keep it on his head. He had to wear it forever, he thought—

He couldn't keep from thinking. He couldn't keep from thinking that something had gone wrong. Something terribly wrong along the line somewhere. He should have come out of school competent and able—and he'd come out a dud. It didn't matter whose fault it was. What mattered was why it happened. He'd done everything they told him to. Every single thing. He'd even let them dim the high ecstasy of new worlds.

That's what mathematics had been for him. He knew something of the history of astronomy and computation when he came to high-school geometry and algebra. He expected it to be the opening of a door to a bright, new world.

But Mr. Carling didn't see it that way. Mr. Carling was a tired, mousy little man who had taught too many courses in Plane Geometry and Algebra II. There was no mystery or magic in it for him. As soon as school was over he had to change to his good, brown suit and other shoes and go out selling ready-made suits of men's

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clothes. Sometimes he even let the class wait while he was showing samples to one of the other teachers.

Even so, Eugene Montgomery doggedly solved all the unreal problems assigned by Mr. Carling out of the textbook fairyland that didn't fit any world either of them knew anything about. He got a straight A all the way through, too. He accepted Mr. Carling's word that geometry was very useful to a manufacturer in knowing how many dustpans he could press out of a certain amount of sheet metal, and it helped the oil companies in knowing how many ships they'd have to have to transport so much oil across the ocean. He gave up the vision of a world of abstract beauty and light he'd glimpsed before encountering Mr. Carling and the ready-made suit business.

Mr. Pond, the physics teacher who didn't like confusion in the physics lab, so there had been no lab work during the course—

Mr. Raily, who was very solemn, and spoke every day of the obligations of world citizenship and the duties of the individual toward his group—

Miss Thompson, who couldn't explain why it was necessary to diagram English sentences, but for whom he obediently did it—

Professor Adams, who constantly interrupted his lectures on Statics with remarks on the high obligation of the engineer towards his profession and the public to see that only standard

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practices are ever employed—

To each one he had adapted himself. They poured it out in lectures and texts. He gave it back in examinations and recitations. And they commended him for his high scholarship.

And none had ever asked: "Do you have an idea that is better than this, Eugene Montgomery?"

No one had ever asked if he had any ideas at all. It didn't seem to matter. As long as he could function as a mental brick wall, bouncing back all they gave out, it was adequate.

But it had been pleasant—warm and friendly and pleasant. He remembered those years as the best of his life. There was no terror there. It was absurd to—

Now it was coming back. Slow, dark waves lapping at the edge of his mind. And he knew why it was there—yes, because he dared look upon himself as a student. The dark, lapping waves were the alternative to docile obedience and absorption of all he was taught. He would have brought them swirling up uncontrollably about his head in those high-school years if he'd dared allow himself to think Mr. Carling was an old fool, deaf, dumb and blind to the wonder of the beautiful thing he was murdering. There might have been a dozen in that class who could have been shown its light and beauty if their tender vision had been nourished carefully.

But Mr. Carling made certain they would never see. With his steady bumbling, that was in itself the peak of efficiency, he blinded their eyes beyond all recovery. And that was his purpose, Eugene Montgomery thought in sudden agonizing fury. Everyone knew it. Principal Martin, the School Board, everyone in the community—there was no one who was not aware of what little suit-salesman Carling was doing. And they did nothing about it.

Homeostat. He fastened down efficiently and tightly his little homeostat that said you mustn't see this beauty—it leads along, too many strange paths to too many strange worlds. It's an ugly thing that you must hate forevermore.

Montgomery had known what was happening even as his own vision closed, and he was helpless to do anything against it. If he had tried to oppose them, even in his private thoughts, he would have been a prey to panic. Now, with the help of the Mirror, he could watch it creeping up on him, feel it flowing through his veins—and not succumb to it. Rather, he felt a strength rising up in him for having dared look upon this hidden nightmare, and slowly the dark lapping waves receded until they were all gone.

He sat there for a long time, waiting for something more. But he knew that was all for the present. He had seen himself for what he was and he had to live with it and understand it. Obsequiously, he had knuckled under to

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every whim of dogma handed out, never daring to question or propose a radically different thought of his own.

He was a coward. But he could look upon that naked, unpleasant fact now without flinching because he knew that somewhere in the Mirror he would find the means of changing it.

V.

He called at the office where Don Wolfe was waiting for him, to let the counselor know he was leaving, but he didn't feel talkative and Wolfe let him go without pressing him for conversation about what he had found.

He ignored the call which the desk clerk said had come through from Dodge. He had reported once today; that was enough. He requested that he be not disturbed by calls of any kind during the night.

It seemed impossible to sleep and he lay for a long time looking down at the rocky shore and the narrow strip of sand at the base of the jutting cliffs nearby. His mind was swarming with confused, tormenting thoughts, and yet he seemed almost able to stand aside, viewing them objectively and without panic.

He seemed to have come a far way from the Firestone Aviation Corporation and the XB-91, where all this had begun. He wondered how Soren Gunderson was making out, if the designer's experiences were as rough as his. He didn't see how they could be. Gunderson was successful and creative.

It seemed to Montgomery that he had almost forgotten the original purpose of his coming. But he had to remember it and evaluate it anew. Was the work of the Institute a hoax and a menace for Dodge and Spindem to bring to a halt? He thought of the Norcross demonstrations with fresh excitement. There was nothing phony about them, he was certain now. He had no positive evidence to support it. His own experience had convinced him. Years of unrecognized but ever-present tension and fear were gone. He could look upon the reality of his own failings without shrinking from the sight.

His position was reversed. He was no longer an agent of Dodge to find a legitimate excuse to close up the Institute. He was an Institute agent who had to find means of persuading Dodge that something of value existed here.

He didn't know how this was going to be done. Perhaps he ought to go to Nagle and Berkeley and confess why he had come. But it wasn't as easy as all that. He was still under orders from Colonel Dodge.

Soren Gunderson was in a foul mood when Montgomery found him the next morning. He was sitting on the lawn near one side of the court, talking with a younger man. His face was dark and unpleasant in a way that Montgomery had never seen before in all the years of their association. Gunderson was

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ordinarily placid and easygoing.

He motioned to a seat. "This is another of the new supermen. Major Eugene Montgomery of the United States Air Force; Mr. Mahlon Rockwood recently of Acme Refrigerators, Incorporated."

The two men shook hands, smiling at each other a trifle uneasily in Gunderson's dour presence.

"Mr. Rockwood has some interesting observations on this matter we're all interested in," said Gunderson. "He thinks our friend Nagle is pretty much off the beam in laying so much blame on the schools for the widespread technological stupidity."

Montgomery grinned sympathetically. It was obvious that Gunderson was trying to unload something extremely potent, and hadn't succeeded yet. He turned inquiringly to the younger engineer.

"I was just saying that most new engineering graduates can't take the risk," said Rockwood. "As in my case, most of the fellows are working at a place where sales are doing nicely on the old lines. They're buying a twenty thousand dollar home in somebody's development—which will have cost them twice that before it's paid for in thirty or forty years. They're expecting to send their own kids to college—they've got one or two now and expect more. They can't risk badgering the chief engineer or the factory manager or the sales chief to come out with something new that might upset the whole refrigeration business, for example.

"So for the new model they decide to hang a butter softener in the door. Or maybe put the coils in the walls—and take them out next year. Then if they feel real daring they'll do something drastic like revolving shelves—produce a real contribution to the science of food preservation!"

Montgomery laughed. "Almost as good as the calico doors we had a year or two back."

Rockwell nodded. "But that's the situation we're in, and I wonder if it doesn't extend even into the aircraft industry in a different form. Nobody in any kind of business wants to change his model as long as the old one sells. That's the basic fact that everybody's overlooking. And when a change is made it must be a minimum—not a maximum—change. Every engineering professor in the country seems determined to keep this a deep, dark secret."

Gunderson snorted. "Wouldn't it be nice if it really were that simple?" He turned to Montgomery. "I'm kind of sorry I got you to come up here with me, Jack. I really thought these guys had something. I guess maybe they still think they do. But they just don't know what they're bucking."

"What are they—and we—bucking?"

"Ever hear of 'steam-engine time'?"

"No. What's that?"

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"Some mystic named Fort thought up the term. It means that when a culture has reached a point when it's time for the steam engine to be invented the steam engine is going to be invented. It doesn't matter who's alive to do the inventing, whether it's Hero of Greece, or Tim Watt of England, or Joe Doakus of Pulaski—the steam engine is going to get invented by somebody. Conversely, if it's not steam-engine time nobody under the sun is going to invent it no matter how smart he is.

"Others have put it a little more elegantly by saying that it is impossible for one to rise above his culture. That's the thing we're trying to buck—and we can't do it."

"If that were true, there would be nothing but stagnation. Somebody has to rise and draw the culture up with him."

"No, no—" Gunderson looked almost angry. "Take mathematics for example. A mathematician does his building on the foundation that's already there. Nobody in Pythagoras' time was going to invent tensors or quaternions. The culture for it wasn't there. Suppose Einstein had been born in a Polynesian tribe. Do you think he would have produced his work on Relativity in that culture?

"Uh-uh. And it doesn't matter how smart we are or how much we get our brains polished up in the Mirror—we aren't going to take the next steps we want to take until the culture is ready for them. That might be fifty years from now, for all we know. You can't lick the principle of steam-engine time."

"So what are we going to do about it?" said Montgomery. "Sit back and wait until steam-engine time catches up with us?"

Gunderson glanced up, his eyes dark, knowing Montgomery was mocking him. Instantly, the major regretted his words. "I didn't mean it that way—I think you'll find the answer in the Mirror."

"That's what Nagle keeps telling me! We went round and round over this yesterday, and all he'd do was smile and tell me to look in the Mirror."

Montgomery didn't know the answer to the argument of steam-engine time. Maybe a man couldn't rise above his culture. He doubted, however, that he had to remain immersed to eye-level height in it forever. But he knew now, at least, what was holding Gunderson back! He wondered what the engineer would find when he searched the Mirror for the answer.

He went almost reluctantly to the appointment with his own Mirror. He felt he had reached a position of equilibrium which he hesitated to disturb. Admitting his own cowardice and inadequacies was more pleasant than what he might find next.

A world of nightmare swarmed up to meet him as soon as he donned the headpiece. He thought he was pre-

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pared for almost anything the Mirror could show, but this was something new.

He had found out how to control the speed, so to speak, of his approach to the image, and he held it down now, feeling his way slowly through the bewildering unknown. It was difficult to keep aware that this was the labyrinth of his own mind he was searching. He couldn't believe that he had walked about daily for his thirty-five years with this nightmare and terror locked up inside him.

It seemed as if all the normal quality of his senses had been stripped away. He had no eyes to see, nor ears to hear, nor fingers with which to feel. But there was awareness of life, a sharp, ecstatic awareness that filled his whole being. It was intense, as if it alone occupied the whole world.

And then there was—death!

It had been approaching for long aeons, slowly dimming the ecstasy. But he screamed aloud when he finally recognized it for what it was. The gradual diminishment of life was like a fire going out in all the cells of his being, and the coursing liquids slowed and turned cold.

He fought back to awareness of his body, and knew he was dying—now. He felt it in his arms and legs. His heartbeat was slow and his breath came in gasps that had all but ceased. He couldn't find light with his eyes any longer. There was only the great, empty shadow into which he was slowly drifting. This was death.

At first he could not discern the enemy. He had believed there was no life but his own. Now he was aware that there was life all about him. While his own was decreasing, this other was growing, drawing from him his own vital force of existence.

He reached out involuntarily to struggle against that enemy and felt it react. He felt the sick flood of its revulsion wash through him, poisoning, destroying. But an understanding came. He could make a bargain—

The enemy was supporting him—how, he didn't know. But his demands had been too great. The enemy rebelled for its own safety and had begun first to withdraw its support, then actively attack him. He could offer to curb his demands, to lessen his requirements. Then they could both survive. He didn't know if it would be accepted. He was at the mercy of the other. But he sent out his offer and his appeal—

Faintly, the fires seemed to rise in the distant cells of him. The liquids were renewed. His offer was acceptable. His life was restored to him again.

But not so high as before. Some of the ecstasy was gone, and the fear remained—the deadly fear that if he demanded his full portion he would be annihilated.

Where did such a nightmare arise? It had diminished, but he was still shaking in every muscle as he became

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aware of the panels of the Mirror. Perspiration soaked his clothes.

It was nothing that had ever happened to him. Of that he was certain. For some reason his imagination had been harboring this fantasy of death, controlling him with it. It had to be a symbol of something else, having no reality in itself.

Hesitantly, he glanced at his watch and then at the panels of the Mirror. It didn't seem possible that he had spent half a day with it already. He ought to call it enough for now. Wolfe had cautioned him to not spend more time than this at a single sitting. But he had to get another look at that symbol of terror and find out its meaning. If it had one—

He went back again and again to look more closely each time, to feel more intimately the sense of death. Until at last he was able to look continually without cringing.

It was late evening when he took off the headpiece. A faint smile was on his lips as he closed the door of the room behind him.

He spent two hours more searching the stacks of the fairly ample library of the Institute. Then he returned to the hotel, and his smile was broader than ever as he entered the door. The psychiatrist, Dr. Spindem, was waiting for him in the lobby.

He arose and came forward, hand outstretched to greet Montgomery. His face was beaming professionally and his eyes scanned the major intently.

"I came as quickly as I could," he said. "I told Colonel Dodge we couldn't afford to endanger unnecessarily a man with your qualifications."

Montgomery chuckled. "I can imagine what Dodge's answer was!"

"What do you mean by that?" Spindem's eyes sharpened their inspection.

"Nothing—particularly."

"You mean you feel the colonel doesn't appreciate you?" Spindem insisted.

"Something like that," Montgomery agreed. "Would you like to come up to my room where we can talk?"

Spindem nodded. "Yes. I want to hear everything you've found out so far about this incredible, so-called Institute."

The psychiatrist remained silent during the ride in the elevator and the walk to Montgomery's room. But the major could feel the constant inspection of his eyes almost as if it were a physical probing. He guessed that he was already written pretty far down in Spindem's little black book.

"Drink?" he offered as they sat down. "I haven't anything here, but we can have something sent up."

"No, thanks," said Spindem. "I'd like to hear immediately everything you've experienced—particularly about this so-called Mirror."

Montgomery began with his experiences of the first day, describing in

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detail the demonstration put on by Norcross.

"What do you suppose the purpose of that was?" said Spindem. "Is it a standard sort of show which is put on for all newcomers?"

"It's no show. I thought it was faked up, too, when I first saw it. It isn't. It's genuine. The men who have gone through enough hours with the Mirror can actually do those things."

"Some form of hypnosis, unquestionably," said Spindem. "You'll pardon my disagreement, but you understand, I'm sure, that my professional experience enables a more accurate interpretation of such mental phenomena."

"Of course," said Montgomery. He continued with Dr. Nagle's analysis of the educational system as a homeostatic mechanism and his own verification of this function.

"A novel concept," said Spindem, "and obviously very naïve, not taking into consideration at all the converse situation if there were no universal distribution of knowledge."

Montgomery started to interrupt, but the psychiatrist continued. "I am most interested in your statements about your high-school mathematics teacher. You say you believe this Mr. Carling purposely and deliberately made geometry and algebra unpleasant to you so that you would not pursue them too far?"

"Paranoid, I believe you call an attitude like that, don't you?" said Montgomery, his face expressionless. "A persecution complex—"

"Please—" Spindem's face looked pained. "I am not here for the purpose of personal diagnosis, major. My only interest is in the effects of this Mirror."

"I'm sorry," said Montgomery. "Your question permits of no simple answer. Mr. Carling was utterly incapable of teaching mathematics in any way that would not make it completely repulsive. The subject held no fascination for him, and it was inconceivable that it should for anyone else.

"The principal was aware of Carling's work, but *he* didn't know there was anything wrong with it, either. The School Board knew the principal's feelings and attitude and considered him a fine man for the job. Everyone knew—but nobody believed anything needed to be done about the situation. And Carling went on turning out his scores of pupils, year after year, who hated mathematics with an almost personal bitterness."

"That is hardly to say that all this was deliberate and purposeful, even if completely true," said Spindem.

"I thought psychiatry was the first to deny that any accident exists in human performance," said Montgomery. "Your teachings are that when an effect is produced by human beings it was the intention of those persons to produce that exact effect. You are familiar with the individual subconscious, but there is a group subcon-

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scious, as well. No one would ever admit it was the purpose of my school to produce haters of mathematics. I say it was the purpose—the unstated, subconscious purpose of the entire group involved."

Spindem made no comment. His lips pressed together in a thinner line as his eyes scanned Montgomery's face intently.

"And the Mirror told you this?" he said finally.

"I was able to determine it for myself, after the Mirror minimized the fear of recognizing this fact."

"And why should there be any fear in recognizing it—if it were true?"

"Because of the unevenness of the contest: me against the whole educational system."

"Or the educational system and society against you?" said Spindem with lifted eyebrows.

"Either way you want it," said Montgomery.

"And is there anything else you have determined from looking into this Mirror?"

"Yes. I found out why I didn't have more courage and gumption to stand on my hind legs and protest people like Carling and his kind. There are other people who have made more of a stand than I have, as is obvious to you. But I simply knuckled under."

"Why?"

Montgomery told then of his long experience with the Mirror that day, the sensation of death and an enemy with whom he compromised to save his life. Spindem listened with interest.

"Have you dreamed previously in this same manner?" he asked as the major finished.

"It was no dream," said Montgomery. "I was wide-awake."

"Of course. In the case of this afternoon's experience—but I would think the same symbolism had probably occurred frequently in dreams during your lifetime. Unless it were induced wholly by the Mirror."

"It was not induced by the machine, and it was not symbolism," said Montgomery. "I can tell you exactly what it was."

"Please do."

"I wasn't quite sure of myself even after a whole day with this experience," said Montgomery slowly. "I spent a couple of hours afterwards brushing up on my psychoanalysis a bit, to see if it was creditable in terms of your field.

"I find your authorities agreeing almost universally that the psyche of the individual has an unknown beginning and a long history antedating the event of its physical birth. My experience with the Mirror confirms it. I was a living, responsive entity at the time my mother's organism tried to destroy me. The event I spoke of was a threatened miscarriage. Through the endocrine flow that passed between us I recognized that I was being killed. Poisons were beginning to cir-

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culate within me and essential elements withheld.

"There was the impression that the maternal body was too weak to support me. My growth demands were too great, and the only way it could survive was by destroying me. And then, on a biochemical level, I made a bargain. My organism agreed with the mother organism to accept less, to limit my demands for sustenance in exchange for the right to live. The bargain was made and kept.

"That was my first major piece of education. I learned that in order to live I must limit myself, always take less than I need, diminish myself to the subsistence level in every way. That was a pattern I have maintained throughout my life. I have never dared create—to do so meant death. I learned that long ago as a fetus, and the lesson remained until today."

Dr. Spindem took a deep breath. "Major, you leave me no doubt about the absolute danger of this Institute. You are treading in the most dangerous areas of human experience. Of course we admit that the human psyche does not come into existence at birth. But it is utterly impossible for you to know that the things you have described ever took place. Even admitting that these fantasies are your own and not the induction of this machine, it is mental suicide to attempt your own interpretation. Only a skilled and experienced professional mind could possibly provide you with a proper understanding of them."

"In the Forties," said Montgomery, "one of your own people, the Hungarian psychoanalyst, N. Fodor, showed a practical method of reaching the pre-birth unconscious and de-educating the individual in the lessons learned there which are no longer applicable to post-birth life. You cannot deny the validity of it. The Mirror is simply an extension and improvement over Dr. Fodor's findings. Tomorrow I shall prove it to you."

"How?" Spindem demanded.

"Tomorrow I shall create something for the first time in my life. I shall create an airfoil which will revolutionize high-altitude flight."

Dr. Spindem stood up. "It is obvious, Major Montgomery, that you have endured a terrible ordeal at the hands of these people who operate this pseudo-analytic device they call the Mirror. It is my professional duty to recommend to your superior, Colonel Dodge, that you be withdrawn from the project immediately. Adequate evidence already exists to force the closing of the Institute. It is morally impossible to allow you to risk your mind further.

"For yourself, I must recommend immediate therapy. In order to minimize the danger of delay I would suggest we arrange for tomorrow morning the first of a series of electro-shock treatments for you. If treatment is begun at once, the effects of this terrible experience should begin to

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disappear within five or six weeks."

"Not tomorrow," said Montgomery. "I have to design an airfoil. Perhaps in a day or two after that."

VI.

He gave the white-faced Spindem an hour to call Colonel Dodge. Then he placed his own call. At Dodge's first word he knew he had guessed correctly. Spindem had said his piece and Dodge was most sympathetic and solicitous.

"My dear major," the colonel said. "I was just about to call you. I want to offer my congratulations and my sincere thanks for the job you have done for us. It's as much as any man could be expected to perform in line of duty and I'm—"

"So Spindem called and told you I was nuts, huh?"

"What's that, major? Oh, yes—I did hear from Dr. Spindem this evening. He said—"

"Colonel Dodge, I want you to come out and see this thing for yourself. If I'm crazy—all right, I'm willing to gamble my sanity for what I've seen out here. This isn't a fake, colonel, or a scheme of sabotage, or anything of the sort. If you think it is, after making a personal inspection, I'll let Spindem fry my brains in an electric toaster for as long as he wants to. But I ask you to come and make your own decision before taking any further action against the Institute."

"That is reasonable," said Dodge carefully, as if he felt he were talking with a child or idiot. "As a matter of fact, I intended to do that anyway. But don't you think you ought to let Dr. Spindem—"

"*After* your decision, colonel!"

There was a pause and Montgomery heard the colonel's sigh of irritation.

"I'll make it as quickly as I can, but it may be three days at least, before I arrive. Keep in touch with the doctor. Don't take any unnecessary risks."

It probably would look bad, Montgomery thought, if he had to be committed to an institution, and word got out that it had resulted from an assignment the colonel had made. Dodge had reason to worry, he supposed. At least, he thought he did.

Montgomery ate quickly in the coffee shop of the hotel. It was still early enough to get in another three or four hours at the Institute. The place seemed to be open most hours of the day or night.

He met Wolfe as he passed along the loggia.

"I'm afraid I can't allow you any more work for at least a couple of days," said the counselor. "I just looked over the Mirror tapes you turned out today—"

"That's all right," said Montgomery. "I wasn't headed for the Mirror. Now that I've gotten rid of a big chunk of my education I want to do

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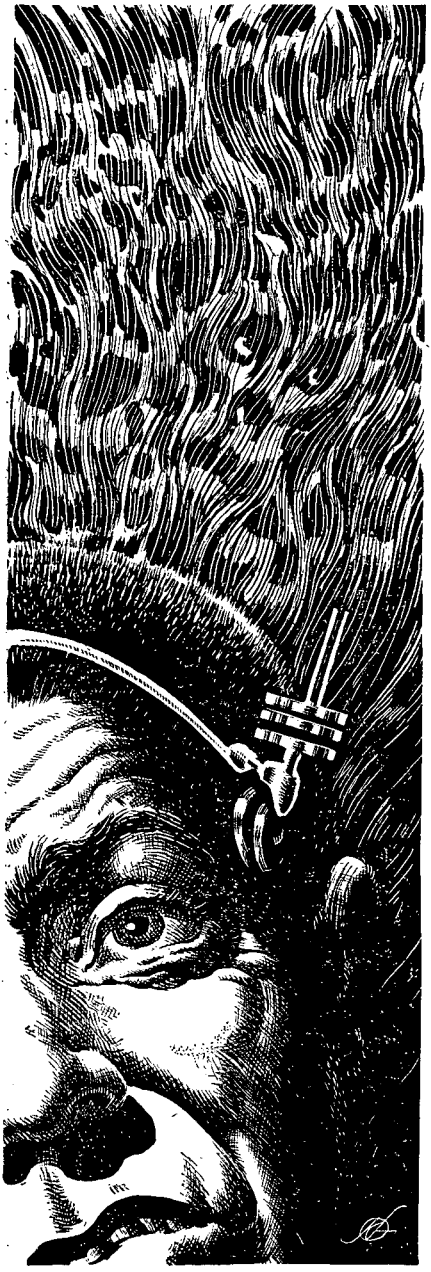

some learning! It will be O.K. for me to work with the shadow boxes, won't it?"

Wolfe nodded dubiously. "Don't keep at it too long. You can say you've really had it!"

Montgomery found an empty learning room and sat down before the cube of the small shadow box there. Gingerly, he put on the headpiece. It was the first time he'd tried it—and even now he was glad he was alone.

The soft glow came on in the interior of the cube. Montgomery hesitated and drew a deep breath. Then he projected an image of the Ninety-one.

He almost cried at the result. A fuselage that looked somewhat like a contorted carrot sprang into being—minus wings and engines. He tried to straighten out the shape and the tail disappeared. He let it go and attempted a wing. The whole fuselage vanished and one wing, with a single engine flaming, turned slowly end over end in the cube.

Montgomery leaned back in sick discouragement, and removed the headpiece. He had thought it would be so easy once his pattern of action ceased to inhibit his creativeness. The lesson of his pre-natal threat of miscarriage was gone. The lessons of Mr. Carling, who had taught him to hate beautiful geometric forms, were gone.

Professor Adams, who permitted standard engineering practices only—and those no more recent than 1908—

They were all gone, and he was like

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a child, crawling on the floor, stacking his first blocks. He had to learn skills with the unused faculties and in that there was agony.

He tried again, building a wobbly plane with melting wings and twisted fuselage. But no panic swept him as he persisted. He was free to learn and create for the first time in his life. He forgot time, and the sun was tinting the beach when he finally looked up from the cube with a small degree of satisfaction with what he had produced. The plane was recognizably a miniature of the XB-91, and it didn't melt and wobble as he tried to maintain its image.

But he had been wrong in his statement to Spindem. Today was not the day he would create a revolutionary new airfoil. He could put it on paper, of course, but that would be a last resort. He wanted to provide a solid model that could be checked in a wind tunnel.

He went to the hotel and caught a few hours sleep. Then he came back to the Institute and resumed work to improve the accuracy of his visualization. For another forty-eight hours he sweat over the project, breaking up the long sessions with the shadow box for only brief intervals of eating and sleeping.

But at the end of that time he was satisfied with his achievement. He had a foot-long model of the Ninety-one with a wing such as no one had ever seen before. He solidified it in plastic.

He called in Gunderson, who was looking much better, as if some of his own problems had been solved. Montgomery didn't ask what kind of experiences he'd been having with the Mirror, however. His time was almost gone.

"I've got to have some wind-tunnel tests by tomorrow afternoon," he said. "Firestone's little variable-pressure tunnel is the only one that will do. I'm completely bushed. Will you fly up there and run the tests and get them back by tomorrow?"

Gunderson picked up the model, keeping his face straight. He ran a finger over the contour of the wing. "Is this the thing you talked to me about when we built the Ninety-one's wing?"

Montgomery nodded. "I know it looks nuts, but I haven't got time to argue it now. If I'm wrong about it, the Nagle-Berkeley Institute closes as of tomorrow night, and ten years of litigation will probably not get it open again."

"What are you talking about? Who's going to close up the Institute?"

Quickly, Montgomery told the engineer why he'd come there in the first place. He told of the country-wide suspicions of the motives behind the Institute, of the approaching visit of Colonel Dodge.

"Dodge will obtain an injunction to close them up. He'll string out an investigation forever. Nagle and Berkeley will struggle for the rest of their

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lives to get into operation again, but they won't have a chance. Opinion will be wholly against them in all quarters of conventional authority.

"On the other hand, if we can swing Dodge to our side when he comes—"

Gunderson shook his head slowly as he looked at the model plane once more. "You think this will do it?"

"Look." Montgomery turned back to the shadow box. He turned it on and created another image of the Ninety-one. Then he provided a visible air stream. "I'll vary it now to simulate flight between eighty and a hundred thousand feet."

Gunderson watched as the luminous streamlines thinned. The model rose at a scale speed that was fantastic. "But *you're* doing that!" he exclaimed.

Montgomery nodded and turned it off. "That's why I have to have the wind-tunnel report to convince Dodge. But the model will behave exactly that way in the tunnel. The lift of the wing is about ten per cent less than conventional shapes at sea level. At the flight altitude for which it is designed, however, the lift actually increases with rarefaction of the atmosphere."

Gunderson's face still showed disbelief, but he picked up the model. "I'll get the tests for you. As for Dodge, aren't you going to tell Nagle and Berkeley? And haven't they anticipated something of this kind?"

"Yes," said Montgomery. "I'm quite sure they've anticipated it. They'll know why Dodge is here."

Montgomery went to his hotel to rest. He had done all he could. Maybe it wasn't enough. Maybe Nagle and Berkeley would have come out better with somebody else in his place. But it had to be played now the way it lay.

He called Dr. Nagle and talked with him for fifteen minutes in regard to Dodge's visit. As he suspected, the only thing that was news to Nagle was the time and the person who would initiate the investigation. It was agreed that Montgomery would bring the colonel over and introduce him and take part in the demonstration that would be given.

With this in hand, Montgomery went to sleep for the rest of the day.

Gunderson returned to Casa Buena the following day, an hour before Dodge's shuttle plane from Oakland was due. The engineer went directly to Montgomery's hotel. His hands were trembling faintly as he unfastened the brief case and handed Montgomery the sheaf of papers reporting the wind-tunnel performance of the model plane.

"This is the biggest thing since jet engines!" he said. "If a full scale design would give the same performance—You should have seen Evans and the rest of the wind-tunnel gang standing around with their mouths open as lift increased while pressure went down. Here's the curve we got."

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Montgomery scanned it with satisfaction. It was just about as he predicted. There was the normal rate of loss from sea level to fifty thousand. It began to pick up a trifle there, and at eighty thousand the sharp, useful rise began. At a hundred thousand it plummeted again.

"If we'd only had that on the Ninety-one—" said Gunderson.

"We could have—if I had been able to take a look at myself in the Mirror early enough."

Gunderson left. Montgomery went out to the small airport at the edge of town to meet Colonel Dodge, who arrived exactly on schedule. Dr. Spindem came along, of course. He seemed uneasy at the prospect of riding with Montgomery, but said nothing. There had been little conversation between the two men since the night of Montgomery's report.

As the plane's passengers disembarked, Dodge approached with cordial concern on his face. "It's good to see you again, major. How *are* you? And Dr. Spindem—"

"Everything is fine," said Montgomery. "I have explained your visit to Dr. Nagle. He has prepared a small demonstration which I'm sure you'll enjoy."

Dodge's lips compressed. "I'm sure I shall," he said.

The colonel took a room at Montgomery's hotel. In a half hour he was ready, after a shower and change of clothes, to go to the Institute. It was a half hour, however, in which Spindem conferred with him, while Montgomery waited in the lobby. The major was aware of a sharp change in Dodge's expression as he came out.

Dr. Nagle seemed perfectly composed, however, as he received the unsmiling colonel, and the faintly contemptuous Dr. Spindem. He and Montgomery smiled at each other as they shook hands.

"I understand you have come to close us down," he said abruptly as they took chairs.

The abrupt challenge startled Dodge, but he yielded no ground because of it. "We have obtained an injunction," he said severely, "which we are prepared to exercise, on the grounds that you have hampered the military effort by inciting men to leave critical posts."

"That is a rather severe action in light of our concept of freedom to move about and do as one thinks best. You have no moral control over these men."

"These are severe times," said Dodge. "But in fairness we are prepared to listen to an explanation of your actions—if you care to give one."

"I should like to," said Dr. Nagle, nodding slowly.

He outlined his beliefs regarding the untapped resources of the human mind as he had done on Montgomery's initial visit. The colonel listened with interest, but without conviction.

"All that is most interesting," he

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said, "but our institutions of learning and research have been at work on the problem for thousands of years. It is hardly likely that they would have failed to find a solution if one were as readily available as you suggest."

"Suppose we view the demonstrations next, then?" Dr. Nagle suggested.

"I should like to say something at this point, gentlemen," said Spindem suddenly. "In my field of work this search for supernormal faculties and functions of the human mind is recognized for what it is. The constant pre-occupation of our society now with schemes of a fantastic nature is pathological in the extreme. Among these we have the Superman fad, the popular dissertations on means of leaving the Earth and going to the Moon, Mars, Venus, et cetera. We have the yearning for means of telepathic communication—anything to circumscribe the necessity for utilizing and perfecting the conventional means at our disposal. It is too much hard labor to understand another man or another nation by perfecting vocal and written means of exchange. If we only had super powers, such as telepathy—presto!—all our difficulties would be over.

"Your assertions are suspiciously pathological, Dr. Nagle. We will improve Man when, and only when, we inspire him to hard work in use of the faculties with which he is normally endowed, and cease to search the clouds for something miraculous."

Dr. Nagle smiled slowly. "Your last statement inspires my wholehearted enthusiasm, Dr. Spindem. And now, the demonstrations, gentlemen—?"

Montgomery had suggested that they not use the musical demonstration, or the similar artistic one, but Nagle had Norcross perform an original symphonic composition. Dodge knew Norcross by reputation and slight personal acquaintance. It was obvious that he was not impressed by the engineer's performance. He simply didn't believe it. He was furiously attempting to devise in his mind a solution to explain the mechanical trickery he thought he saw. To explain the mechanism involved, the reason behind Nagle's use of it—and Norcross' reasons for participating in it. He got no answer to any of the items.

Spindem, on the other hand, was rather entranced by the music. He listened uncritically, as if he could believe, for the moment at least, that it was being produced in the manner Nagle described.

There was a demonstration of art work, produced in full color in the shadow box. A half dozen students went through as many complicated problems of electronic design. Civil engineering and aeronautical designs were created in profusion.

It seemed to Montgomery that the very weight of material shown should

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break down Dodge's skepticism, but he remained unmoved.

"I have seen nothing yet for which I could accept your explanation, Dr. Nagle," he said. "These mysterious shadow boxes of yours—I'm afraid a much easier explanation for them can be found—"

"You will be allowed the opportunity," said Nagle. "But we have saved the most important item until last. This was produced by one of your men—"

He drew out Montgomery's model and specification sheets along with the report of the wind-tunnel tests made at Firestone.

"What's this?" Dodge demanded. Then he bent to an examination of the articles before him. After five minutes he glanced up in disbelief. He sat down at the desk and read and reread the papers.

He looked up a final time, searching for Gunderson, who had been brought in at this point. "You conducted these tests yourself, and can verify this report?" Dodge asked him.

Gunderson nodded. "It's absolutely true. The Firestone lab crew will vouch for it, too."

"This is amazing!" said Dodge. He got to his feet and faced Nagle. "At least you have one genuine item that is difficult to discredit. But there is still nothing in it to convince me that your Institute had anything to do with enabling the inventor to produce it. I fail to see how—"

"The man responsible for that design is well known to you," said Dr. Nagle. "It is the work of Major Eugene Montgomery."

There was ten seconds of absolute silence in which Dodge turned slowly to face the major. His face was incredulous. "Montgomery," he breathed, "you—"

Major Montgomery held up his hand. A bitter smile was on his face. "Let me say it, colonel. I think I can make it easier for you. I know the whole story—and I doubt that Dr. Nagle knew that I was fully aware of it.

"He and Dr. Berkeley were most certainly aware that they could not disrupt the military production of the country without producing severe repercussions. They prepared an answer. I'm it.

"I caught on pretty early. At first I was puzzled that they would even let me in. Everybody else around here ranged from competent to genius. I was the only knucklehead in the whole bunch. Then I understood. I was to be the horrible example. If something could be made out of *me*—

"You knew, of course, that all my associates considered me a first-rate dope," he said to Nagle. "I imagine Gunderson must have been in on it, and given you a thorough run-down on my incapacities. I know now that I was assigned to the Ninety-one simply because that project was too big to be loused up by me. Isn't that it, colonel?"

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"Montgomery, I didn't mean—" The colonel dropped his hands to his sides.

"It's all right," said Nagle, smiling. "Major Montgomery doesn't mind at all that you had him classified as a mental butterfingers. The important thing is that he no longer is such. He designed this new wing. The incompetent, fearful Montgomery you have known could not have done it. It required the changed, courageous Montgomery who has taken a look in the Mirror and knows what he is capable of doing and is no longer afraid to do it."

Dodge was silent, then suddenly he grinned and thrust forward his hand to Montgomery. "I guess there's no use denying we've had you pegged for a blockhead right from the beginning. We put you in Firestone because it was a place where you could strut around to your heart's content without really hurting anything.

"But, if these people have done something to you to enable you to create a design like this—well, we're going to have to find out what it is. I want a look in this Mirror for myself!"

Dr. Spindem opened his mouth tentatively for the first time. His lips moved as if he were having difficulty in speaking. He said finally, "I've always fancied myself something of a musical composer. Do you suppose there would be any chance—?"

When the others had gone, Montgomery remained alone with Nagle. They went back to the director's office.

"I hope you honestly have no regrets that we chose to use you for a guinea pig," said Nagle. "Everything began moving in on us much faster than we had anticipated, your R&D, the FBI—"

Montgomery shook his head. "I have no regrets. All I ask is that I be allowed to finish now, on the same basis as the others."

"You don't believe you have finished? How far do you think there is to go?"

"I suppose that's the routine you give everybody," said Montgomery. "At least, I hope you're not trying to brush me off. You told me I could look in the Mirror and ask myself who I am and what I'm doing. I did that."

"We are not brushing you off," said Nagle with deep sincerity. "A man stays as long as he likes. He finishes with the Mirror only when he is able to see nothing new in it."

"I got just a glimpse of an answer to the question of who and what I am. I'm a human being—Humanity."

Nagle nodded slowly without speaking.

"It's in me—all of it," Montgomery said. "There's something in me that has been alive since the first spot of slime was thrown up in the seas and energized by a photon to become a living thing—something that has not known death between that moment and now. And all its wisdom and

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learning is hidden in me—in you, and all of us. I want it."

"You can have it," said Nagle, "if you can accept the cost. You know what it's like. You've seen a little, but it's only a sparkle of light reflected in a drop of water, compared with the full, sweeping image available to you.

"You've felt a little of the terror that keeps men from dropping the old, outmoded solutions to problems and facing the problems anew to get fresh, workable answers. If you look any farther, you'll know that every man is the heir to all the terror and risk the human race has experienced in three billion years of development. It's the terror that plagues him in nightmares and insanities and whittles his abilities to those of a midget when he ought to be a giant.

"It takes courage. We can stop the Mirror down to a microscopic aperture, so to speak, but you have to contribute your own courage or you will see nothing. If you have it, however, you can make all the wisdom of the race your own personal possession. The kind of wisdom that enabled it to develop through three billion years of boiling and flooding, attack by all other life forms and slaughter by its own kind. He's made a lot of mistakes, but Man has become a very tough critter, and his wisdom is enormous in a racial sense."

"I'll tackle it," said Montgomery. "I may not make it, but I'm willing to be one of the expendable ones."

"The expendable ones—"

"It's my own term, but I think it fits. I got a glimpse of what you meant by the homeostatic mechanisms of the race. The expendable ones are those who dare to attempt functioning without the homeostats.

"I thought that first day you were trying to tell me the homeostats should be destroyed, that the schools, for example, should be replaced. I see I misunderstood you. The school is necessary, so are all the other homeostatic mechanisms, in order for the race to function as a unit.

"The race can't afford to take a chance. It has to be sure its movement is in a forward direction. Sometimes we think it is going full speed in reverse, but over the last three billion year period the general direction has been forward and up. To make sure it doesn't go off at a wild tangent and lay itself open to every crackpot idea that comes along, it provides homeostatic controls to suppress the wild fluctuations of its members. The school, the church, the media of communication all act to inform the individual members that This is the Way. Anything else is out of line.

"The controls are pretty hard to keep in adjustment. They get set too low in periods of widespread, compulsory education, as you tried to tell me. Compulsion breeds rebellion, and the school begins to fail as a learning factor. It needs to be put back on the pedestal where it once was, and ad-

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mission made a goal, not an obstacle.

"As it is, we are approaching a standstill. The One Right Way is suffused with bitterness and rebellion in all segments of society. The fire is burning pretty low.

"Steam-engine time is a fallacy. It's neither right nor wrong. The race moves forward because of individuals who throw off homeostasis and step out of their culture. It prepares them to take the risk which it cannot take. They are expendable. They may go in the wrong direction and be destroyed. This is of no concern. What matters is the one or two individuals who find a better way. They come back and battle the homeostasis to prove they've found it. Sometimes they haven't the courage to win this battle and the race has to wait for a better man, who can change the homeostatic setting of our institutions. This may be wasteful, but we get a picture of the alternative when dictatorships break up all homeostasis and substitute their own control."

"We hoped you would see it this far—and want to go on," said Nagle. "We pushed you pretty hard. Because we knew Dodge was getting set to attack, we more than tripled the natural fear-level control ordinarily used. We couldn't wait for weeks, we had to have you now.

"Wolfe was sure it had cost you your sanity after that first run. I was a little worried, too, but I knew from your actions that you had to have a great deal of courage or you would not even be alive. I was certain you had faced death somewhere and had licked it positively and deliberately—at terrific cost to yourself.

"The threatened miscarriage was it. You were already so near death that only an organism of extreme determination could have fought its way back. I knew you could take almost anything."

"Expendable—almost from the very beginning!" said Montgomery with only the faintest trace of bitterness.

"Yes," said Nagle, "all of us. You'll find that a billion years ago the race began to prepare you for this moment. It wants us to take an assignment—if we're willing to accept it. A certain avenue is to be explored. Maybe it's a blind alley and all our work will end in failure. But we'll go down it alone. We can afford to take the risk. The race cannot. If we find it's a good way to go, the race benefits. If we make an error, the race will pass us by, being saved from going the way we have gone.

"It's a lonely business, but would you have it any other way?"

THE END

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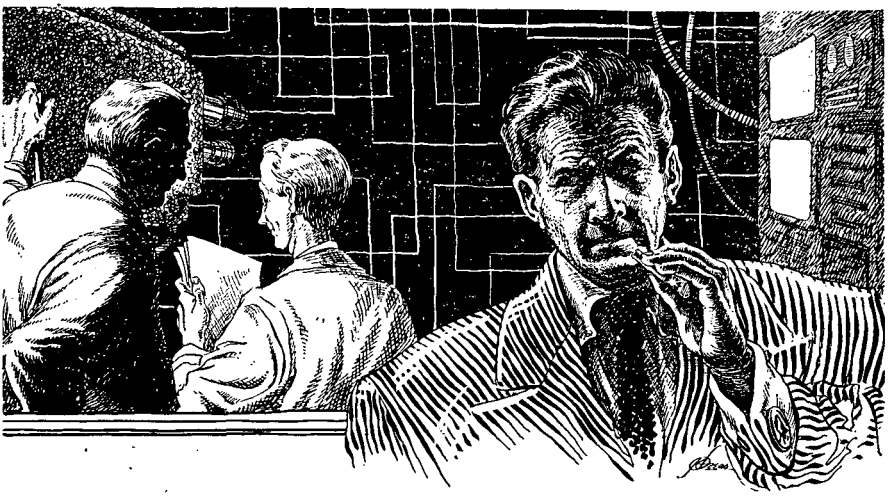

SPECIAL EFFECT

BY J. ANTHONY FERLAINE

There are always some people who feel the way to be a Big Shot is a matter of relativity; if you tear everyone around you down, that'll make you look big, won't it?

Illustrated by Freas

For a second I forgot that the brakes had air in them and almost thumped the new Olds in front of me before I could get the thing stopped. The Olds belonged to Jay Smith our so-called production manager. What a laugh! The stupe never saw a TV studio until three years ago — when he saw this one. Just shows you what marrying the right girl will do.

I slammed the car door and walked toward the back entrance. Nice day. If I didn't get out to lunch I wouldn't see the sun again until tomorrow morning — unless the boss called me in about something or other, in which case I could admire the buildings across the street from his picture window. Talk about the poor coal miners —

"Hi, Ed! What's new?"

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Look at that one! Done already. I suppose he thinks that this early-morning show he's directing is some stuff. Where does it take talent to direct a guy sitting at a desk yakkin'? I remember him when he was a floor man, flipping cards and pushing scenery around — and not very good at that either. Now he thinks he's in the same league with a guy like me who's been in the business since long before they ever built this joint. Kids! Directors! Ha!

I should have gone to New York years ago. Could have, too, I bet. Forbes would have asked me, when he went up as general manager of that new independent, if that apple-kissing Frank Weems hadn't big-talked his way along with him. Saw his name on the credit list of Stage 46 the other night: "Produced and Directed by Frank Weems." I'm laughing!

They only direct one show every two weeks up there and they've got a budget and talent besides. Who wouldn't be good! Here I am in Philly directing twenty shows a week — with no talent and no budget. Who do they think they are around here anyway: Paying a guy a lousy hundred bucks a week and all the guff you've got to —

"Hello, Mr. Richards."

Now why can't I call that guy by his first name? Barlow does. Of course, he knew him when —!

He didn't mention the audition that I'm going to direct next Monday. Guess he'll call me in after I get done with "Cooking is Fun." What a title! What a show! Why do they put a guy with real talent on a schlocky show like that? If that dog wasn't sponsored by the M.C.'s brother-in-law, or something, it wouldn't be on the air five minutes.

I stopped by my office before I went into the studio. No mail. Just a couple of general memos from Harkness about network changes. I wonder why they bother to send me this stuff anyway? I guess Harkness has to have something to keep himself occupied.

I noted the rehearsal schedule and headed for Studio 3.

The camera men and the crew chief were sitting on the set drinking coffee when I got there. Dom Thoor was rigging a dry-ice bucket over two pillars on the adjacent set.

The crew chief volunteered a "Hi, Ed."

I know the guys hated my guts. I made them work too hard. That was another laugh come to think of it. With their union, *nobody*, not even Richards himself, could get them to move faster than a slow crawl.

I waited until everybody had finished their coffee. By this time Rick White, the talent on the show, had shuffled in and we started a *so-called* rehearsal. He ad-libbed the whole show anyway so it didn't make much difference.

The agency man wanted a run-through on some dealer tie-in cards that he had sent over. Holy cow!

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Would you believe it — These yokels had twenty title cards with names and addresses. Twenty flip cards one after the other for a minute and a half straight. Now I ask you: Who wants to look at twenty names and addresses for a minute and a half one after the other?

I argued with the agency man about the twenty cards right up until about five minutes to air time. He kept saying that he didn't like it that way either, but Mr. So-and-So wanted it that way and so what could he do. I gave up and went to the control room.

Jules St. John, my assistant director, was practicing on the control board when I got there. I lit a cigarette and sent him down to re-sort the flip cards. Cocky kid! Already he thinks he's a big director. There's a lot more to directing than pushing buttons, I'll tell you. Seems like everybody and his brother wants to be a director nowadays.

The system cue came up on the monitor followed by our station identification. I was ready on the opening cards when master control gave me the "Stand by." Jules was saying: "Quiet in the studio, stand by, please," over the earphones. I cued the music and we were on the air. After the fanfare I punched up Rick White on Camera Two and leaned back and lit another butt. After you've done the same show every day for a year straight you get so you could almost do the thing blindfolded. All I had to do now was to follow Rick and his girl assistant around and punch up a close-up every time they referred to whatever it was that they were brewing.

The show was as dull as ever with the exception of a guest ballerina who did a three-minute bit. Don't ask me what a ballerina has to do with a cooking program — but there it was. Dom Thoor had rigged up a cute effect with the dry ice over the set. White smoke poured down the columns while the gal danced. It was very effective. I made a mental note to ask him how he got that twinkling star effect along with the smoke.

Dom Thoor was a queer sort of duck, when you stopped to think about it. A real life Ichabod Crane if I ever saw one: Big head, long neck, protruding Adam's apple. And that skin of his — off white, shiny. Come to think of it, I never saw the guy smile. Great special effects man though — great! Awful closed-mouthed about how he does some of his stuff, too. Now take those stars in that smoke effect; how did he do that? Superimposed them I'll bet. Yeh, that's it . . . Hey! Wait a second! Who's directing this show anyway? I don't remember putting a camera on any super job!

After the show I dropped by Richards' office. He was on the phone. He waved me to the chair opposite him while he talked. Boy, I'd like to tell this guy off some day and bounce out of here with a big fat offer in my

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pocket. What does he do anyhow? Dreams up an idea. Gives it to me. I do all the work — and he gets all the credit. If I could get behind that desk for just one week, I'd make these guys around here sweat.

"You wanted to see me, Mr. Richards?"

He gave me the details on the audition.

"Look, Connors," he said, looking at his fingers, "we've got a real big thing here. Outside of 'Wednesday Varieties' we've never had a smell on the network. Here's a chance for us to do something new and different enough to get us a spot on class A network time. There's a sponsor interested and there's even been some talk of putting this opposite Berle. We've never attempted a dramatic show before, but New York will expect this to be as good as — or better than — the best."

I nodded wisely. This was my meat — a real dramatic show, first-class stuff. It looked like my angel was working overtime. I estimated the probable director's fee on a sponsored network show. Connors, this is it! The gravy train is in.

"No fluffs, Connors! You understand?"

Richards raised his voice.

"No excuses! No alibis! This has got to be right! The pilot script is ready and the cast is already set. You'll have cameras Friday, Saturday and Sunday. Don't waste the time! I want scenery, props and effects finished and set up by Saturday. Dress rehearsal Monday morning. We pump to New York at 4:00 o'clock Monday for a kinescope."

He handed me a green folder and walked towards the door. This was my cue that the conference was at an end.

Who did he think he was, treating me like a rookie director? Picking a cast and everything before he ever consulted me. I didn't even know the name of the show yet.

I glanced at the presentation cover as I walked down the hall. "The Federal Broadcasting System Presents 'Destiny.'" I turned the page, sat down at my desk and lit up, "'The Alien,' by Dominic Thoor." Well for — A science-fiction series with a pilot script by Dom Thoor. What was he doing writing scripts? Why didn't they ask me? I could write the best science-fiction script they ever heard of. Now I *was* scorched! Science fiction, my love, my pet, and they let some special-effects guy write scripts for a big thing like this. It's a wonder that they had enough sense to pick the right director.

I read the thing through. Not bad from a production standpoint, but, oh — what a hackneyed plot. I could take a dozen books off my shelf at home and show you the same story with different settings and characters. You know the one: An Alien from a far-off planet comes to Earth disguised as an

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Earthman. His mission: to warn us that our atomic experiments must stop or our planet will be destroyed. Naturally the alien's efforts to warn us are ridiculed and we are left wondering whether or not Earth will be blown to smithereens.

Oh! What the devil! A job is a job, I always say. I'd do the best job of directing that these birds ever saw. I'd make them sit up and take notice — even with this corny script. Then, after we sold the show, I'd move in and do the thing the way it should be done.

I hopped the elevator down to the lobby and strode into the coffee shop for a second breakfast. Jean Bellows, the boss' secretary was perched on a corner stool: I spun the one next to her and sat down. This babe had what it takes in the looks department. Don't think she didn't know it, too.

"Hi, Hon!"

"Hi, Genius! Why don't you go sit across the way so I can sit here and enjoy my coffee all by my lonesome."

Who did she think she was kidding. This hard-to-get routine was as old as the hills.

"Did you see Richards? He was looking for you."

I admitted that I had.

"What's the deal on Thoor writing scripts?" I asked.

"No deal! Just good writing, Junior. He came up with a good show idea and a good presentation. Richards sold the network brass on the idea with Thoor's sample script and now everything's set; that is, if you don't schlock it up with a lot of trick effects and fancy camera shots."

"How come nobody said anything to me before this?" I asked.

She turned away from her coffee and faced me: "Listen, Stupid. Consider yourself lucky that Richards even picked you to direct. He was considering Barnes, but he couldn't pull him off the morning show."

This dame really hurt sometimes even though I knew she was only kidding.

I caught up with Thoor in Studio B after lunch. The guy gave me the creeps sometimes.

"About this show we're going to do," I said. "I guess you know that some of the effects in here are going to be almost impossible to do."

"Which ones?" he asked.

I read the opening sequence that he had written: "'Superimp titles over long-shot of entire solar system as seen from approaching spaceship. Take out titles. Dissolve to closer view approx. the orbit of pluto. Move in at fast pace until the Earth appears as a small green sphere. Zoom in close, past full shot of Moon on the left. Close in on the Earth. Bring up clouds until screen is blanked off. Then, as the clouds thin out and the continents appear, zoom straight down until about two thousand feet from the surface of the Pacific Ocean. Zoom along the surface of the globe until the outlines of

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land appear. Zoom straight down on land mass of what appears to be the United States. Zoom into the ground in what appears to be a landing of the spaceship.'

"Now I ask you," I said, in self-righteous indignation, "how in the devil are we going to get an effect like that? Granted we might be able to get a star blowup from the planetarium and dolly in on that. And we could use a globe of the Earth on a black thread and move in on that for the zoom shot! Some dry-ice smoke superimposed over the globe would give us the cloud effect. And some V-2 films would do for the landing shot over the continent. But, this is going to tie up about three cameras just for the opening alone, and even at that it wouldn't be the greatest."

"We could put the whole sequence on film," Thoor said, unsmilingly, his saucerlike eyes bulging.

He was so serious I was almost sorry that I had spoken so caustically. Those eyes of his — they looked pink, like a rabbit's, when you got up real close to him. Probably in bad health; he was a hard worker.

"Films," I said. "We haven't got time to make films by Monday — even if the models were all built and ready to be shot. Besides, we haven't got a motion-picture camera in the place that can follow focus on a zoom shot."

"I've got some equipment at home," said Thoor, his eyes never leaving my face. I can make the models and have the film here, in the can, by Friday noon."

This guy was really asking for it. O.K. Give a man enough rope! I'd make sure that Richards knew that Thoor had promised the job and then I'd let him go and hang himself.

"Friday noon?" I said. "You've got yourself a deal. If you can do it, you're a better man than I."

The goof! It takes the lab two days just to get the stuff souped and printed. I'll bet a buck he'll come in on Thursday and ask me if we can do the job the way I suggested. Then he'll expect me not to tell Richards that he muffed the job.

"There are a couple of other little things that will have to be changed," I said. "Now take this shot of the saucer taking off after the alien is left on Earth."

"I'll take care of that, too." Thoor said. "I'll bring the film clip, and any others called for in the script, in on Friday along with the opening sequence."

Boy, this guy would be lucky if he had a job come Friday. No one — not even the biggest film house going — could deliver quality stuff like this on such short notice. And while he was fiddling around trying to make a film I'd drop in the Five and Dime and pick up a toy rocketship. They had a lot of that sort of stuff around nowadays. I was a handy guy with tools. It would be a snap for me to rig a

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small rocket on a black thread so that it would move against a star backdrop. Then, when Thoor reneged on the film, I'd have the gimmick all set and Richards would think that I had whomped up the rocket on short, short notice. That would put me in solid.

"Now this shot here, where the alien is walking down a ladder from the saucer, will have to go." I said, smiling. "The whole thing would only run about ten seconds. It would be foolish to build the ladder and the edge of the spaceship for just that one shot."

This guy Thoor might be a great special-effects man, but he didn't know from nothing about writing a script for television. You would think that even the most unseasoned writer in the business would realize that you just don't build full-sized replicas of anything unless you're going to use it more than once. The simplest thing to do, of course, was to show the alien standing on the ground holding on to a ladder that went up and out of the picture. Then, when the saucer was supposed to take off, the alien could just look up and the sound effects would do the rest. We'd never have to show the ship at all.

"Well," said Thoor, looking away from me for a change, "as long as Mr. Richards has consented to let me play the part of the alien, I was thinking that I could put that shot right in the film along with the opening sequence. It's as you say, only a five- or ten-second scene, and there is no dialogue, only background music, so we might just as well film it along with the rest. I have a small model at home that I can photograph. I can shoot myself against a black curtain and print both films together so that it will pass for the real thing."

"*You're* playing the part of the alien!" I said. I was so shocked that I almost shouted. "Has Richards gone off his rocker? First a corny script and now I have to do a dramatic show with amateur talent yet. Are you kidding?"

"Why no!" said Thoor. "I thought you knew. That was one of the conditions that I put to Mr. Richards when I presented the idea. I felt that I knew how the alien would react to the people of Earth and, therefore, how the part should be played. Now, take the last scene where the alien does a coast-to-coast appearance on television —"

"I know the one you mean all right all right! That's the corniest part of the whole crazy story! If I were a creature from another planet, I'd walk straight up to the White House and knock on the door. If the alien wanted his message to Earth heard, he wouldn't go to all the trouble of getting himself on a TV panel show to do it!"

"Maybe he already had been to see the President!" Thoor said, eyes on mine. "Besides, in what other way could he reach so many people, so many *millions* of people, at the same time? Don't forget that this alien is

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not a belligerent person nor is his race warlike. He merely wants to warn Earth that her dangerous experiments must stop or her planet will cease to exist. I believe that I know how this man must feel. Lonely . . . lost among strange creatures . . . wanting to tell each and every one of us, but fearing to do so until as many people as possible hear him at one time."

"Nuts!" I said. "If a race of people other than ourselves wanted to tell us something, they'd drop over the capital in a spaceship and say, 'Listen! — *Or Else!*' Believe me I know my science fiction backwards and forwards. I've got every major publication of any account from way back when. And when I tell you that this story of yours is overdone and overworked, believe me, *I* know what I'm talking about."

Thoor was visibly shaken. "I didn't think that you would feel this way about it, Mr. Connors. If you do not wish to direct this show, I'll speak to Mr. Richards and see if —"

"You'll what?" I shouted. "If anybody drops out, it will be you, Kiddo! Not me! We'll do this audition from your script all right — *But*, when this thing really goes on the air — *I'm* picking the stories. And I'll pick my own *cast*, too. It just so happens that you hit Richards with a science-fiction show just a few days before I could get my idea in to him. Pure luck! We'll sell the show all right. After that, *you* stick to your business and I'll stick to mine."

I was really boiling now! I got up and walked off, leaving him standing there. If this joker hadn't tried to run the show, I was going to try and talk Richards out of firing him after he loused up the film. But now he could go and cut his throat for all I cared. I never did like his looks anyway come to think of it. It was those foreign ways of his I guess. That accent of his for instance; I never could quite place it — not German exactly, or Russian either, but it was foreign all right. Some of these foreigners thought they owned the country after a while.

I was as busy as the devil for the rest of the week getting everything lined up. We had a dry run without cameras for the cast on Thursday afternoon. Thoor wasn't as bad an actor as I had imagined him to be. In fact, he was quite believable at times. I never told him, of course. As a matter of practice I don't believe in complimenting anyone for doing the job they're getting paid to do. I was only talking to Thoor when I had to anyway. Friday was the day! If those films weren't what they were supposed to be — which they wouldn't — I was going right in to Richards.

The scene shop had most of the sets up and dressed for camera rehearsal on Friday morning. I would have raised the devil about some of them just on general principles, if I wasn't so intent

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on the film delivery date that afternoon. I had been pushing Thoor as much as I could during rehearsals so that he wouldn't have any spare time to work on them, but for some reason he didn't look very worried. Of course that face of his was like a mask anyway. It was hard to tell what he was thinking or feeling.

After lunch I went back to the office to wait for him and sat there for nearly five minutes before I noted the film cans in my desk basket. There was a note from Thoor taped to them telling me to meet him in the projection room. This I would have to see! I grabbed the cans and headed down the hall.

Thoor was coming out of Richards' office as I went past. He fell in with me and we walked in silence to the projection room. Let him do all the apple polishing that he wanted to. In just about ten minutes Richards would have him on that blue carpet in his office and then we would see who the wonder boy was around here.

The projectionist was still out to lunch so Thoor laced up the film himself. I sat on a folding chair looking as bored as I could.

The screen went white as Thoor clicked off the lights. Several foot of leader went past and then a shot of the entire galaxy appeared on the screen. The camera moved in and singled out a star. It grew larger. That, I gathered, was supposed to be our sun. The sun moved to the left of the picture as we drew closer, until it disappeared altogether. Then we were looking at a planet in the distance. The planet was distinguishable by the rings which encircled it. I was wondering how Thoor got the ring effect around Saturn when another planet hove into view. Mars! The chump had actually put little canals on its surface. Strictly Sunday supplement stuff. Any science-fiction fan knows that the canals on Mars have been disproven. I could see Venus rotating in her orbit on the lower right of the screen for just an instant before the camera veered off and pointed straight at a green sphere, very small, in the center of the blackness . . . Earth! I forgot for a second that this was only a film of a plaster globe spinning on a string. The jet blackness with the stars clear and unblinking stirred the blood in my veins and set my pulse to racing. If I could only live fifty more years, and still be in good health, I might one day look out the porthole of a spaceship and see a scene like this. Fat chance of that! They say that television is a young man's game — and they're right . . . You don't live long enough to get old in this racket.

I dragged my thoughts back to the screen. The camera was racing in towards Earth. I could see the Moon cold and barren on the left. It zoomed larger as we veered off. Good model! The craters looked as real as any I had ever seen on a photograph. I could see the clouds obscuring the globe that was Earth. We moved closer. I could

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see dark masses that must have been continents and then, we were hurtling through the clouds. I pulled back in my chair. How did he get that cloud effect? Slowly the continents became more distinct. The camera moved more slowly as the clouds began to thin out. We were over the Pacific Ocean. I could see the water as if from a great height. Smaller clouds drifted far below me. The camera stopped moving for an instant and then swung to the left and raced along the horizon. I could see the continents and then cities from far up. The United States!

The camera stops again momentarily and then slowly descends on open country. Closer . . . Closer . . . We're going down! About twenty feet from the ground we stop. The camera tilts for a second. We're down! Now the camera is facing the huge underside of a spaceship. It towers above us. A round hole appears, as if by magic, in the side of the unbroken hull. A ladder slides down. A man is coming down it, his back towards us. He turns. It is Dom Thoor — the Alien. He looks up and the ladder disappears. The hole suddenly becomes shiny metal again. He waves. The monstrous thing shifts. It rises imperceptibly — Yes, it is rising! Faster! Faster! Faster! The disk shoots upwards and — is gone. The screen goes white — The screen goes white —

I sat facing the white screen, staring at it. Thoor threw on the lights. The lights! I felt stupid!

Thoor was saying, "Well, what do you think of it?"

"Huh? Run it again!" I said.

I sat through it three times. Then I got up, put the film into the cans, put them under my arm, and left. Thoor eyed me through the door from across the room, but he didn't say anything. I had a feeling that he could read my thoughts.

I turned the thing over and over in my mind as I walked. There wasn't much time to stew over it. I had to decide.

Richards was alone in his office when I got there. I walked in and shut the door after me. I knew that he didn't believe me at first, but the part about the stars convinced him. I pride myself on being a good talker. He agreed to let me handle the whole thing. He didn't even want to look at the film. I was glad of that. This was going to be a pleasure.

I found Thoor in his shop, a cluttered two-by-four under a staircase. He must have known that I was coming. For the first time since I had known him he looked upset. His big eyes darted around the room. To my face. Away. Back again — as if looking for a way past me. A way out. I was enjoying this.

I decided to make a little speech.

"Look," I said, "let's get a couple of things straight. I haven't got anything against you personally. And I will admit that your film is good — but let's not kid each other. *Or*, what

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I should say is: Don't *you* try to kid me. You know as well as I do that the film won't do. Don't you?"

He stared at me as if I had just taken leave of my senses. Suddenly I was afraid of him. I lit a cigarette and walked over and leaned uneasily against a workbench.

"Look, Dom," I said, "people are a lot more informed on space travel and the conditions that prevail outside Earth's atmosphere than they have ever been. Any informed layman can tell you that a spaceship would seem to hang still in space among the stars — even though it was accelerating at thousands of miles per hour. Or take the canals on Mars — people know that these are only optical illusions. Just try and fool the public with a shot of Mars with painted canals and watch the letters pour in. They know. You'd be surprised. Get the point? I'd sooner have something authentic in concept than perfection in modeling and filming. Unfortunately — for you — Mr. Richards agrees with me on this. *And*, it is our combined desire that you leave the —"

He literally exploded!

"Don't you dare fire me! You . . . you conceited fool! Why, I'll —"

The words couldn't come out fast enough. He was boiling. His face turned a reddish purple. It was the first time in two years that I had ever seen him blow his stack.

"Fire me? I *quit!* You hear me! I *quit!* I don't care what they say. I *quit!*"

He pushed me aside and reached for a black tool behind me. I thought for a second that he was going to hit me and jumped aside.

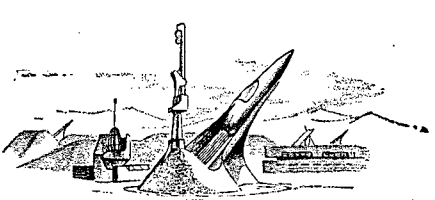
"The hell with you *and* this company! The hell with everybody! The hell with the whole world!"

He stalked out. And that was the last I ever saw of him.

Just as well, too. Anybody who would blow his stack like that was obviously unbalanced. No place in television for psychos or anybody of that sort.

I hear that he got himself a job down at Las Alamos or Oak Ridge. One of those places. Hydrogen bombs. Atomic energy. That sort of thing — you know. Nothing important you understand. Just a mechanic's job or something like that . . . I d'unno.

THE END



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"ON THE CARE AND BREEDING OF PIGS"

Please refrain from writing letters of protest until you've finished the story. This one made me mad, too . . . at first!

BY REX JATKO

Illustrated by Freas

He had the feeling that something was wrong as soon as he came in sight of the house. He kept trying to figure out what it was as he trudged along, bowed under the weight of the meat, but he was too near exhaustion to think clearly. He plodded across the weed-grown field, through the gaps in the straggling fence and into the yard. He went up the steps and into the kitchen and set the bloody hindquarter of beef on the sink, put the sack containing the liver beside it, placed the rifle in the corner and collapsed into a chair.

"Sis!" he called. "Liver tonight!"

There was no answer. The house creaked here and there and the late afternoon sun made patterns through the broken windowpanes but all was still.

He sat there listening a moment, his body rigid in his bloodstained clothes. He could hear the blood still pounding

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in his ears. He brushed the long ragged hair out of his eyes absently and got up.

"Sis?" he called again.

He looked out the back window and saw the clothes dumped on the ground. He went out the back door in a rush, toward the clotheslines. He slowed as he reached the tangle of muddy laundry and looked at the ground.

The signs of a struggle were plain in the dust. A man, a big man from his tracks, had come swiftly up behind her as she was carrying the wash up from the creek, had picked her up—the tracks became deeper—and carried her to the front of the house. He followed the tracks as they led around the house to the far side of the old barn.

He had placed her in a car, turned it around and driven away. The tire tracks led down the road and turned eastward on the edge of the highway where they were lost on the concrete.

He walked slowly back to the house, his mind numb. His sister was gone; kidnaped like in the old adventure stories. He went into the kitchen and sat down on the chair again while he tried to think.

He looked at his hands. They were filthy, covered with dried blood and grease. He got up woodenly and went to the sink to wash. He reached over and took the kettle off the hook that swung over the fireplace. Then he knew why he had felt that something was wrong when he came in sight of the house. There had been no smoke from the chimney.

If his father hadn't been such a saving man and had gotten a lifetime battery for that shiny new stove over there in the corner—or better still, had gotten an atomic pile to power the whole house—they might have torn down these fireplaces. His grandfather had built the fireplaces when he first came to Armine, migrating from Earth to help establish the colony on this planet.

He knew that he would think better if he ate so he built a fire in the hearth and swung a kettle of water over it to heat while he got some vegetables out of the bin. He washed the liver and took out a knife to slice it. As he picked up the knife he suddenly remembered. Of course! It couldn't have been anyone else. They hadn't known anyone else was alive since the plague that had killed Dad and everyone in the neighborhood three years ago. Then just last week this big armored car had pulled up into the yard.

He had been home that day, trying to get some more of the garden planted before it got too hot. He had come into the kitchen to find out when dinner would be ready when they heard tires crunching outside. He followed his sister out onto the porch. Behind the heavy glass of the armored car he could see a man and a woman. They seemed just as surprised to see someone else as he and his sister were.

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The woman got out carrying a short heavy gun in both hands. As she came up to them they could see that she was a tall slim brunette. She smiled at them and said, "Just the two of you here?"

They nodded.

She went past them into the kitchen, noted the two plates on the table and came back out.

"O.K., John," she called to her companion. As he got out of the car she turned to them and said, "We're kind of careful these days."

The man came up and stood beside her. He was a big man, maybe two hundred pounds, looking very neat in a suit and tie against her dull-green coveralls. They stood there looking at him and his sister, appraisingly and yet as if they had found something good under their Christmas tree and didn't quite believe it.

He stirred uneasily and his sister spoke, "Come in the house, why don't you? We didn't know anyone else was alive."

"We didn't know any more people were alive," the man said as they all went into the kitchen. "There's a group of us east of here, about sixty miles, but we haven't been able to find any more until now. We were looking over these outlying areas again when we saw your smoke. We didn't see any signs of life when we came by before."

"Oh, our regular stove went off, the battery ran dead so we had to use this old fireplace," his sister said eagerly. "You say there are more folks alive? We looked all around here but we couldn't find any."

"There are just a few of us, about twenty. But let me introduce ourselves. I'm John Corell and this is Margaret Gardner."

"I'm Amanda Slater and this is my brother Roy."

John shook Roy's hand.

"You're looking around for survivors?" Roy asked. "In those clothes?"

"Why, yes," he smiled easily. "No reason why we survivors shouldn't wear the best available. Of course, I'm not too hard on them since Marge does most of the rough work."

"So I noticed," said Roy.

Amanda broke in. "You mean you just take whatever clothes you want? We could go and get anything we like without paying for it?"

John looked at her. "Who would you pay? And with what? The money is only as good as the government behind it and I'm afraid this colony doesn't have a government any more. So you can take anything you find. You'd probably have trouble finding clothes though, most of the towns are burned out."

"We noticed that around here. I guess it's because most of them are still made of wood."

"And also because there were no fire squads left. The capital of the colony was more modern so we managed to save it from burning. We can

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get almost anything we want there."

"I'd like to get some pretty clothes like I used to see when we went into town."

"No reason why you can't. Both of you come and live with us. We survivors should stick together."

"Oh, I'd like that. Someone else to talk to, pretty clothes and things." She turned to her brother. "Let's go, Roy."

"Dad wouldn't have wanted us to leave the home place," Roy replied. "Besides we don't know these people. We're not going to go running off just to please a dude like that."

"We can't stay here forever," Amanda pleaded. "We don't have any soap, no meat, the clothes are wearing out, the power is going off. Let's go!"

John reached over and switched on the light. He noted the dimness of the bulb and said, "You won't have any power soon. These atomic batteries have a rather short half-life. We have power piles where we are so we'll have power for a long time."

Roy's face was set and stubborn.

Amanda spoke. "Roy, he's right. And you've killed the last of the pigs so we won't have any food except vegetables unless you hunt all the time. If you do, then the garden suffers and we won't have enough food to get through the winter. What do you say?"

Roy was silent so John spoke again. "You can live much easier with us. We have ample food. The capital city, Culloden, had a quick-freeze plant for crops and a slaughterhouse. They are both refrigerated by power from atomic reactors so they'll keep the food indefinitely. Besides we need both of you to rebuild the colony again."

Roy glanced at his sister. She didn't seem to get that.

"He means that you'll have to get married and have children," he explained.

Amanda was undaunted. "I have to get married some time and there isn't anyone around here." She turned to John. "How many men are there?"

John replied cautiously. "Unfortunately the virus mutation that wiped us all out was most effective against males. There's just Stevens and myself but he's pretty old."

"So she'd have to marry you," Roy said triumphantly, "and you probably have a wife already. She'd be going into bigamy!"

John got a little red. "I have seventeen wives," he snapped, "and if you think that I'm desperate for another one, you're crazy. But we won't rebuild this colony at all if we don't do something."

Amanda seemed rather dazed to think that she'd be wife number eighteen.

"You see," said Roy. "You're not going into a harem like that. Dad always said you were going to be a good girl in spite of not having a mother

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around. And I'm going to see that you are."

John started to speak but Marge who had been standing by silently, interrupted. "How old are you?" she asked.

"I'm seventeen," Roy answered, defensively. "Sis is a year younger."

"Don't argue with him, John," said Marge. "He's at that age."

"But, Marge," said John, "you know how important it is to get started now while we have a balanced and varied food supply for the mothers and children."

"I know," she replied. "But we'll have to go about it another way."

Something about her tone alarmed Roy. He moved over to the sink and picked up the knife there.

They both looked at him for a moment, then the air of tension eased as they relaxed and John spoke.

"Well, you'll have to come to us when your food runs out anyway. Do you have any transportation?"

"We have an old truck. It's not in very good shape though," Roy answered, still eying them warily.

"Well, it's only sixty miles. We're in the governor general's mansion in Culloden. Do you know where Culloden is?" Roy nodded. "You can find us there any time, we'll be waiting for you. Nice to have met you, we'll meet again soon, I'm sure."

He held out his hand to Roy who backed away. He smiled briefly and the two of them walked out and drove off.

He should have known they were up to something, Roy thought as he looked back on the incident. They might have captured him then if he hadn't had the knife. Apparently they didn't want to risk getting hurt. He turned back to the liver and began slicing it.

He finished his dinner in the dusk and went into the living room, turning on the lights. They were getting dimmer rapidly now.

"Too bad Dad put off buying everything," he said to himself. "We needed a new battery before the virus came along."

He looked through the books on the shelf and found a map of the colony. He marked out the route to Culloden, noting that the highway ran along a river as it came by the town. Then he went to his room, put on his pajamas, said his prayers and got into bed.

He lay there in the dark, noting how quiet the house seemed. There was no sound except for the creaks of the old building and the faint empty whistle of the wind. He used to talk to his sister through the wall but she was gone, taken by force to a harem, to be the eighteenth wife of a cowardly dude.

"I'll bring her back," he thought. "We'll be together again."

But his mind wouldn't let him rest at that. "Bring her back for what?" it asked.

"We belong here. This is our farm, our place."

"You can't live here without food.

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You have to leave."

"She's not going to stay there with a bigamist. It isn't right. She was raised to be a good girl." He closed his mind to further questioning and fell asleep, exhausted from his long hike homeward carrying the meat.

But in the gray morning when he awoke things seemed different. He lay there under the warm covers and thought bleakly of the task before him, of the troubles he would have to face. A desire to stay in bed and have someone care for him swept over him, a desire to cease the endless struggle for food and let someone else take up the burden. With an effort he remembered his father saying, "Begin to start, the rest comes easy."

He got out of bed with a struggle, out of all proportion to the task and got ready for the journey. He ate and made up a lunch, putting everything away neatly. Then he got out the rifle and its few shells and went out the door, locking it behind him.

He opened the doors to the barn and rolled the truck out. As he closed the doors again he took one last look around. "Thank the Lord, I don't have any pigs to worry about." He got into the truck and went out on the highway, heading toward the sun.

It was late afternoon when he came to the bridge which led across the river into the town. He looked warily about feeling that someone was watching. He saw no one, the silence was complete, broken only by the water gurgling against the bridge pilings. He looked at the water, longing to cool his feet in it. It had been a long walk from where the truck had broken down.

He looked around again and went across the bridge, holding the rifle ready. Nothing moved in the sunlit street ahead of him. It seemed as empty as the countryside he had come through.

When he had gone a couple of blocks into the town, past the rows of silent houses he heard a noise behind him. He whirled about and saw a police car turning out of a side street and coming toward him. He looked around and ran toward a large weathered house that had a sign in front advertising "Rooms." He dashed down the driveway beside the house and into the paved courtyard in back. Facing him was an eight-foot board fence. He ran to the back door of the house throwing his weight against it as he turned the knob. It was locked.

He went to the fence and tried to climb it carrying the rifle. He couldn't manage it, the rifle was in his way. He heard a car door slam and with a sense of increased urgency he started to throw the rifle over the wall. He thought of what an eight-foot drop would do to the rifle if there were concrete on the other side, too. He stopped at the thought; he couldn't do anything without a weapon and it had belonged to his father.

He heard the sound of running feet

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in the driveway. He swung the rifle around, his back to the fence and covered the driveway.

Two women came running into the courtyard. They were unarmed and there was no place on their brief shorts and halters where they could have concealed a weapon.

He pointed the rifle at them automatically. They seemed to know that he wouldn't fire for they came toward him quickly, one of them reaching for his gun. He recognized her as she came up. She was the brunette who had been out to the farm a few days ago.

"Give me that before you hurt someone," Marge said.

He clung to the rifle as she grasped the barrel, resisting her pull.

She looked at him calmly and spoke to the other woman who had come up beside him. "Trip him, Sally!"

She let go of the rifle and gave him a sharp push. He fell backwards over Sally's outstretched leg.

Sally seated herself on his chest and Marge wrenched the rifle from his hands. He blushed as he became conscious of the softness of the blonde seated on him and of the faint smell of feminine perspiration. He blushed even redder as Marge ran her hands over him looking for further weapons. He lay there helplessly, his ears burning, as she slid her hand into his pocket and took out his jackknife.

If they noticed his embarrassment they didn't show it. Sally spoke. "Have you got everything, Marge?"

Marge nodded and she got up from his chest.

They took his hands and manacled them together and stood him up. Then started to lead him away, but he didn't move. Marge said, "Don't be stubborn. We can carry you if necessary."

He shook his head and said, awkwardly, "The rifle, it belonged to my father."

"If we bring it along, you'll come quietly?" Marge asked.

He nodded. Sally picked up the rifle and they went out to the car. Another squad car was there and some more women were getting out of it. They looked at him, nodded to his captors and went back in the car. He heard one of them talking into a microphone.

He got into the car between Marge and Sally. As they drove away Marge asked, "What took you so long? We expected you by noon at the latest."

"The truck broke down about twenty miles out," he answered dully. Then he turned to her. "You expected me?"

"We knew that you would come after your sister. We picked you up so that you wouldn't try anything foolish."

"Then you took Sis just because you knew that I would follow? You want me and not her?"

"You don't seem to understand how important you are, Roy. There are twenty women here including your sister. You and John are the only

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males left on this planet as far as we know, except Stevens and he's seventy."

"Then my sister won't have to marry John?" he asked, hopefully. "He doesn't really want her?"

"Suppose you talk to John," Marge replied. "He's here at the mansion."

The car went up a driveway lined with tall trees and came to a stop in front of a large long building.

Roy got out and stopped and stared. Sally noted his awed look and said, "It used to be the governor's mansion. It has everything, stables, swimming pools, even a private golf course out in back."

Roy looked at the plate glass and field stone front as they walked toward the front door. He turned as an automatic mower came around the corner of the building, humming across the wide front lawn.

"Stevens used to be head gardener here," Marge explained. "He likes to keep the place neat. He has a whole fleet of those things on the golf course. He's using every self-powered mower in town while their batteries last."

They went through the wide door and into a vestibule. It was more like a lobby, Roy thought. Two magnificent staircases swung up on either side and murals covered the walls. They continued on into a mahogany paneled study. John was there, sitting behind a desk.

"Glad to see you, Roy," he said,

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coming toward them. "Nice to have you with us." He started to put out his hand and stopped. "Take those handcuffs off, Marge. He won't do anything here. Not as long as we have your sister, will you?" He smiled and Roy's blood chilled. His eyes were not smiling, they were cold and merciless.

"Sally, go bring Amanda here. I want you to see that she is all right before we talk," he continued.

Roy sat down in the leather chair indicated and John turned to Marge. "Easy enough, wasn't it? Did he ask any questions?"

"Not really, he was slightly put out. I told him how important he was though," Marge replied.

Amanda came into the room and over toward Roy. He stood up and they faced each other awkwardly, both feeling relieved at the sight of the other but not knowing how to express it.

Roy took her hand and asked, "You all right, Sis? You weren't hurt?"

"I'm all right, Roy. He just carried me off. He gave me my choice of coming peacefully or getting hit on the head—so I came."

"You wanted those pretty dresses like the one you have on, was that it?"

Amanda flushed. "Yes, I did. And he told me that you'd be here today and here you are. So there was nothing to worry about except that old farm and I'm forgetting about it as fast as I can." She tossed her head defiantly.

"Where did you get that?" he asked, pointing to the diamond ring on her left hand.

"I'm engaged," she replied, looking at John.

John spoke. "Suppose you run along now, Amanda. You girls go, too. Roy and I are going to talk."

When the girls were out of the room, John went behind the desk and sat down, leaning forward on his elbows.

"Marge gave you an idea of how important you are to this colony here on Armine. I want to make sure you understand. What I'm going to say will probably be very bitter medicine for you to take. Amanda gave me an idea of the Biblical sort of father you had and of how strictly you were raised."

Roy started to protest but was silenced by a wave of his hand.

"You were brought up on a farm. You raised hogs, I understand. Why had you run out of pigs to eat when we were there?"

Roy answered sullenly. "The boar got through the fence and ran away."

"You had no other males? What about the baby pigs?"

"They'd all been gelded. A small farmer doesn't raise his own boars anyway, at least not often."

"You faced death by starvation because there were no more little pigs. Right?"

Roy nodded reluctantly.

"This colony could die out the same way, couldn't it? If there were no

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males, there'd be no children and eventually no colony. Am I right?"

Roy said nothing.

"Fortunately we have two males, you and I. You just mentioned that you didn't raise your own boars. Why?"

"They're not good meat. We couldn't afford to raise them."

"I mean the main reason."

"You get better pigs if they're not inbred," Roy replied, seeing the point of the argument, but not liking the possible consequences of his admittal.

"Exactly. Now I want you to stay here and think about it for a few days. As insurance that you won't leave, I'm going to tell you something. I am in the position of a raiser of pigs. I have two males and twenty females. If I have to slaughter a female to keep a male, I'll do just that." His eyes turned as hard as stones. "In case you don't get it, I mean that if you run off like your boar did, your sister will die."

Roy's heart sank as he looked at the flinty face before him. He knew coldly that John was capable of doing precisely that.

"Of course I don't think it will come to that," John continued after a pause. "There have been quite enough deaths in the past three years. I say it to show you the power I have and to make sure that you will promise to stay here for one week without trying to leave or do anything rash."

He went over to a bookcase, took out a Bible and came toward him. "Put your hand on it and give me your word."

Roy could see no way to avoid it. It didn't seem to be too much to ask though, just one week. He put his hand on the book and promised.

"You're going to marry my sister?" he asked as John put the Bible away.

"She's getting her wedding clothes ready now. We'll be married in a couple of days. We like to make a ceremony out of it, makes it seem less like the breeding of pigs."

"But you already have seventeen wives," Roy protested.

"Did you worry about the number of wives a boar had? I didn't turn the virus loose you know, I was as helpless as anyone else. But I want to rebuild the colony here as fast as I can. You are going to help me, and the sooner you start the better. But since I can't force you to marry I want you to think it over. You'll see that I'm right.

"You'll stay here in this building with the rest of us. In a couple of days you'll give your sister to me in marriage as the man of the family. That's a feature we've been lacking in the previous weddings."

John got up and said, "I'll show you to your room. You'll want to shower and change clothes. We're having a celebration tonight, a dinner in honor of you and your sister. It will be in formal clothes to make a real occasion out of it."

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He led him up one of the stairs to the next floor. Roy blinked his eyes.

"Are all these bedrooms?" he asked.

"Yes. There are ten bedrooms on this floor, each with bath. Two of them are master bedrooms with a sitting room. The other stair leads up to a wing just like it."

"The government built this, you may remember, just before we were granted the status of a self-governing planet in the Solar Federation. It was just another way of saying that from now on we are on our own, Earth doesn't want any more of our problems. But, of course, there had to be a ceremony and so we were host to the officials who came here to preside over the affair. In order to impress the officials with our modernity this place was built to accommodate them while they were here. It's built as well as they knew how, the latest and best of everything. It even has its own private water supply and its own power pile in the basement."

He led Roy into a lavishly appointed sitting room, through it into the bedroom. As he showed him the bath he said, "This is one of the master bedrooms of this wing. Stevens has the other. Eventually your wives will all be on this floor. I have a similar set-up in the other wing."

Roy was too dazed by the splendor of the apartment to react to his statement. He looked at the immense blue tile and glass bathroom.

"You mean all this is just for me?" he asked, incredulously.

"You'll get accustomed to it," John smiled at him. "There's no one else to use it so we may as well. It'll last us our lifetimes or until Earth starts this colony again."

He turned to go. "I'll have someone bring you some clothes while you're getting cleaned up. Dinner will be ready in an hour."

Roy stripped and went into the bathroom, hoping he could solve the intricate maze of valves and plumbing. When he came out a little later, feeling fresh and clean, he found that his old ragged clothes were gone and in their place was a set of formal ones like those he had seen in pictures. He put on the trousers dubiously, thinking of what his father would have said about the clothes, and was struggling with the shirt when he heard a knock on the door. He pulled his trousers up and opened it. A gray-haired man in formal clothes was standing there.

He walked in and offered his hand. "I'm Stevens," he said, his weathered face breaking into an easy smile.

Roy hastily changed his grip on the trousers and shook his hand. Stevens reminded him of his father, the same weathered look. The wrinkles on his face seemed to have been made by laughter rather than frowns though.

"I'm Roy Slater," he replied, smiling back at him.

"I know. I'm here to give you a hand with your clothes if you need it.

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Studs are a nuisance."

"I was just trying to get the shirt on," Roy said.

Stevens looked at him closely. "Better take it off and come into the bathroom with me. Ever shaved?"

Roy was startled. "No. Am I supposed to?"

"That fuzz is pretty long and your hair could stand a trim. Come in here."

He sat Roy down at the dressing table and wrapped a towel around his neck. He got out scissors and comb and began cutting his hair.

"You seem to be pretty good at this," Roy said, watching in the mirror. "You don't talk much like I thought a gardener would talk either."

"Oh, I've done a lot of things in my life," Stevens replied. "Bend your head a little forward. I used to work on the spacers, you know, the freight carriers. It's too hard a life when you get older though. I went back to Earth to retire but I couldn't stand it, too crowded and the people are different from what they used to be. All the adventurous ones migrated so the rest were pretty dull, at least to me. So I migrated here as a gardener."

Roy changed the subject abruptly. "How come we survived? I mean, why didn't we die like the rest?"

"I don't know exactly. A matter of personal resistance I guess. You'll see at dinner that most of the people are young adults, under twenty-five except for Sadie and me. I imagine we were tougher than the rest of our age group, we've both led hard lives. There's another exception too, Alice. She's only ten but she was raised in the gutter and must have had a lot of resistance. The virus was pretty deadly though, out of the millions on this continent there are only twenty-three left, that we know of."

"What about the rest of the planet?"

"John has a radio going all the time, automatically covering all wave lengths. He has a transmitter going, too. We haven't heard a peep from anywhere else in over a year and a half now. That doesn't mean that there's no one else alive, of course; it means that if there is anyone alive they don't have our facilities and/or our knowledge.

"But I don't think there are any others." Stevens clipped expertly at the back of Roy's neck. "Used to do a lot of barbering on the spacers; somebody's got to, and only the passenger liners carry barbers. After forty years or so of amateuring, you get pretty good at it."

"Why do you think there isn't anybody else?" Roy protested. "This group here lived, my sister and I lived —why shouldn't there be lots of other towns like this? Why do we have to get forced into this group? What if the others don't have radios?

"And how do we know that the Federation isn't sending in ships now?"

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Stevens stopped clipping for a moment and looked at him with a wry twist of his head. "Son, you haven't been around much. Guess you were a bit young when the Plague was going to get the picture.

"Men knew—all of us in the spacers knew it for certain-sure—that one of these days Man was going to hit a planet with a Something we couldn't handle. Just a question of time and number of planets. We *hoped* that when we hit the Something, we'd know we couldn't handle it soon enough to back out, or at least that only those that hit it would be checked off. But we knew, too, that that was the Big Risk—that somewhere, sometime, Man, in trying to get the whole danged star-system under control was going to hit something that the *race*, not just the explorers, couldn't handle.

"Look, son—the Plague didn't hit us here; it hit the human race. The last messages that came through indicated old Earth was hit hardest, as well as first; what planet that virus rode home from, no one ever did find out. It had an incubation period so long it was pandemic before we knew it existed at all.

"Most of the human beings on Earth were homebodies; the venturesome ones went out, you know. And they didn't have a lot of people who'd had a lot of immunizing shots for a lot of cockeyed planets. The Federation government collapsed before we did here.

"And these girls didn't live here, Roy. There were about forty girls that called in by radio, from various parts of the planet, in answer to John's signals. John came halfway across the continent himself, heading for this place here, because he knew what it was and what it had—complete self-contained facilities.

"The girls that made it, to here, Roy, are some damn fine kids. They've got my respect; they crossed about a quarter of a world full of death to make it. The twenty others that called in didn't make it—but they tried like blazes, Roy.

"Now you listen to me, on this one." Stevens fixed him with a stern glare that made Roy think again of his father's weatherbeaten, stern face. "Those girls don't want to talk about it; they won't mention it. You've been having a soft time on that farm of yours, compared with the job they did. They've had some time to get over it; don't go asking 'em what it was like.

"Every single one of those girls, Roy, is sweet and soft on the outside—but believe me, they wouldn't have made it here if they hadn't been made of spring steel and sheer atom-powered determination. There aren't any other towns like this; the girls don't just *think* there aren't. They pushed corpses out of their way to get here.

"Several of those that didn't make it simply broke down; nobody could help them.

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"And nobody can help us. It wasn't just *us* that got hit by this plague; it was the whole Federation. We don't know, and can't know now, that there is another human life in all the galaxy.

"We took the Big Risk—and the race came mighty close to a dead loss. We're the only insurance we know of—and it's a mighty small policy."

Roy sat silent for a moment, the slithering *chlick* of the scissors the only sound. His tone was quite different when he asked, "Couldn't we leave? I mean, take a ship and go back to Earth or some place?"

"How are you at recalibrating cybernet systems? Or repairing hyperdrive units? I can navigate—if nothing whatever goes wrong. And there's no place to go that's better off."

Stevens stepped back and looked at his handiwork.

"Well, that's about all. Come on, I'll help you dress."

When Roy surveyed himself in the mirror a few minutes later he was amazed at the transformation. A tall, clean-faced blond youth looked back at him. Dressed in evening clothes he looked like something out of a magazine.

Stevens smiled at him. "It gives you a shock to see that you can look like a dude, too, doesn't it? The sleeves are a little short, the governor general's secretary wasn't as tall as you, but otherwise you look all right. How are the shoes?"

"A little large," Roy replied, "but I like them nice and roomy."

"We'll go downstairs to the study. John wants to see you before dinner."

John met them at the door of the study. He wore his clothes with an ease that Roy knew he could never match. He looked Roy over critically and led them in.

"Good job, Stevens," he said over his shoulder as he got out a decanter and glasses. He poured three drinks and handed one to each of them.

"To the new world," he said, lifting his glass.

Roy looked at the glass in his hand. "Is this hard liquor?"

"Yes," John replied. "Now drink it." He looked at Roy with hard, uncompromising eyes.

Roy shifted his feet uncomfortably. John continued to look at him, lifting his glass to his lips. Roy lifted the glass and drank it hurriedly.

His eyes watered but he set the glass down and waited for the burn to subside. Then he heard Stevens say, "May the new be better than the old," and realized that there was another drink in his hand and John was looking at him again. He tried to smile and shake his head, but he knew he would have to drink it, too. He lifted his glass as they did and poured it into his mouth, not swallowing. It felt like liquid fire on his tongue so he gulped it down. It burned and tasted bitter and his eyes watered anew. He kept his face rigid, trying

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not to show his revulsion.

John offered him a cigarette but didn't insist when he refused. A slow warmth was creeping up from his belly and spreading through his limbs. He sat down and relaxed, realizing how keyed up he had been. John said, "Feeling better?"

He nodded, not trusting his tortured throat to speech.

"Good. We'll go into dinner now."

Roy walked between them to the dining room feeling slightly dizzy but noting that the clothes seemed to fit better and that he felt more at ease in the magnificence around him.

They entered the dining room, immense in the subdued light. The room seemed filled with bare-shouldered women in bright dresses. Marge came toward them, slim and sophisticated in a black low-cut evening dress. Roy stared at her. She said hello, smiled at them and walked away, swaying her hips.

Amanda came up in a strapless evening dress but after Marge's it seemed quite proper, even conservative. She looked at him shyly and said, "You look nice, Roy."

Roy smiled at her warmly and said, "So do you, Sis." He reached out and gave her a hug.

She looked at him, surprised, and then said, "You've been drinking."

"Just a couple to relax him a bit," said John. "Let's sit down at the table. Roy, you sit here on my right and Amanda, on my left."

Roy sat down to a bewildering array of dishes and heavy silver. John sat down beside him and selected a fork. Roy realized how hungry he was and, carefully choosing the same fork, began eating.

He took his first bite and swallowed it in amazement. He hadn't known what food was, confined to a diet of vegetables and pork or any kind of meat that he could find to kill, and that badly cooked and seasoned only with salt. He began to eat voraciously, scarcely noting the women who were serving, each taking a turn so that no one would be up from the table for the whole of the dinner, until Marge set the dessert before him. As she leaned over him to pick up the used plate, he became conscious of her perfume and of her body in the low-cut gown. She straightened slowly and gracefully with the dishes, smiled into his eyes and turned away.

The whole room seemed to jump into focus after that, the women down the length of the table, Stevens at the other end, the black and white of his formal clothes standing out severely against the soft shoulders and gay dresses of the women, the quiet movement of the women who were serving. Everyone seemed happy, even the ten-year-old girl in a party dress who was listening to the women talking beside her. He had to shake himself to remember that this was all that was left, that this represented the human

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race as far as they knew.

He turned thoughtfully to his dessert, eating it appreciatively, but with his mind elsewhere.

Over their coffee, he turned to John. "This is all that you've found?"

John smiled. "It gets you, doesn't it? Yes, this is all except for the babies."

"Babies?"

"You don't think that I waited for you before I started the long road back, do you? I didn't know you existed. Most of the women here have had children, several of them are with child now."

Roy looked closely at them and saw that a few showed unmistakable signs of pregnancy.

"You're the father of all of the babies?"

"Yes. Stevens is too old. Don't look so amazed, it has to be this way. Remember the analogy of the pigs.

"Unfortunately not all of the women can have children. Sadie, the gray-haired woman with the intercom—it leads to the nursery—is too old, Alice is too young and Marge and Sally just haven't had any, although there doesn't seem to be any reason, medically speaking, why they can't. That, in case you were wondering, is why they do the dangerous work."

"How many babies are there?"

"There are twelve, two of them are males. We lost a lot of them at first, apparently the germs were long lasting, at least we think that they had a residual effect, the boys died faster than the girls. But now I think that we're past that stage. We should be able to have children as fast as the health of the mothers will allow. They are all young and healthy so they can have them fairly close together. Their youth has another advantage, they can learn things easier. I want them all to know as much as possible and be an expert in at least one field, as expert as you can get by reading. That way we can save a lot of time when we have to do things for ourselves. At least one person will know something about what to do and where to find more information on any subject."

"I'm afraid that I'm not much of an expert on anything," Roy said, looking down at his cup.

"Don't be silly. You know something about farming, raising pigs, hunting—you'd be surprised at the amount you know when you think of it. But we'll talk about this some other time, now I have to make a little speech."

John got up and spoke briefly, formally introducing Roy and Amanda and welcoming them to Culloden.

The dinner broke up after that and as they left the dining room, John spoke to Roy and Amanda. "I've given you adjoining rooms until the wedding so that you will feel more at home. I suggest that you relax a little, Roy, and get a good night's rest. You

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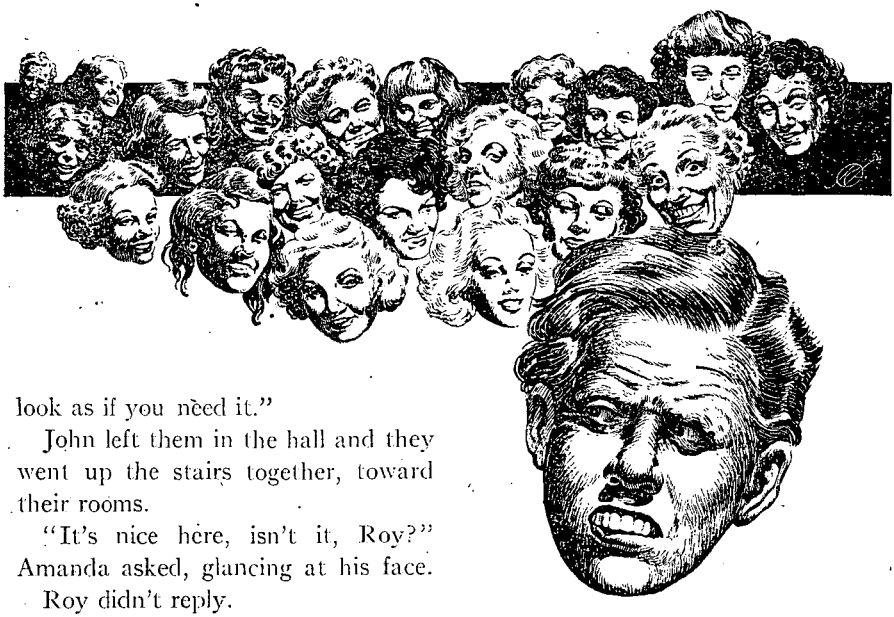

look as if you need it."

John left them in the hall and they went up the stairs together, toward their rooms.

"It's nice here, isn't it, Roy?" Amanda asked, glancing at his face.

Roy didn't reply.

"It's much nicer than at that old farm," Amanda continued, less shyly.

"That farm belonged to us and it was Dad's before us," Roy replied. "This doesn't belong to anyone here."

"Don't be impossible," Amanda said. "It belongs to us because we're all that's left."

"It still doesn't belong to anybody. Not like the farm did. Just like these clothes don't seem to be mine for all that Stevens said I could have them." He turned toward her. "But the main thing is that we don't belong here either. We don't belong with all these strangers with education and fancy clothes, who can make conversation and eat dinners with more silverware than they need."

"That dinner was an occasion. We're the first they've found in over a year and you're the only male since John started this group. They usually don't eat like that. It's too inefficient."

"We still don't belong here."

"Where do we belong except with people like us? You want us to stay on that farm and starve to death?"

"No. But we just don't fit in here. At least I don't." Roy turned into his bedroom and closed the door on Amanda. He couldn't face her practical questions now, he had to think about it.

He found pajamas in a drawer, said his prayers and got into the huge bed. He lay there in the dark, worrying the problem in his mind. A sense of the unreality of his surroundings came

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to him as he stretched out and relaxed. What was he doing here in this fabulous mansion among these strange composed people, with their smoking and drinking and indecent gowns? Their figures seemed to become exaggerated, the hard and dominating eyes standing out alone, the woman with the dress abbreviated to nothing, her bare flesh swaying before him—

Roy awoke with a start. He looked about for a moment trying to place himself. There was a line of daylight underneath the drapes at the window. He went over to them and opened them. The sun was high, it was almost noon. "I guess it was that long hike yesterday," he said to himself.

He washed and looked for some clothes. The ones he had worn last night had been put away. Someone had been in here while he was sleeping. He looked through the closet but could find none that were like the ones he had worn on the farm. He dressed in the plainest clothes he could find and went downstairs.

He reached the hall and looked around. Marge left the book she had been reading and came toward him. She was wearing a bright yellow playsuit that went well with the large amounts of brown skin it displayed. She noted Roy's gaze and changed her walk slightly, swaying up to him.

"I'll take you in to lunch," she said in a husky tone, making it sound like an assignation. "Then we'll go downtown and get you a better fit in shoes."

She took his hand and led him into the kitchen. She pointed out a chair for him, served him and seated herself opposite him. Roy tried to keep his eyes on his food but Marge seemed unaware of his surreptitious glances. As he was finishing, she intercepted one and smiled at him. He blushed and stood up.

"You don't get this service every day," she remarked. "I'll show you where to clean the dishes and how to put them in the washer. You'll learn the routine fast enough."

When that was done she took his arm and led him out to the car. From somewhere on the playsuit she produced a key and they drove away.

"Do you want anything besides shoes?" she asked. "Shirts, socks, underwear?"

Roy shook his head.

"I think you do," said Marge, glancing at his averted face. "We'll go down to the department store and clothe you from the skin out."

They sped down the broad silent streets at a fast clip and stopped in the "No Parking" zone in front of a huge store. Marge knelt and opened the glass door with a key.

"Is the whole place locked up like this?" Roy asked.

"The whole town," Marge replied. "Every place is locked, everything shut off. Cuts down the possibility of fires and damage. We want it to last as long as possible. Some of the stores

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are sealed and boarded up for future use." She led him through the door. "This way; the men's section is over here."

Roy followed her trim figure toward the racks of clothing. The building was utterly quiet, their feet made no sound in the thick carpeting. Roy had a sudden choked feeling of the intimacy of the moment.

"Here are the shoes," said Marge, matter-of-factly. "Do you know what size you wear?"

He shook his head.

"Take off those shoes, I'll measure you."

She sat down on the stool and took his stockinged foot in her warm brown hands. Roy's eyes fixed themselves unconsciously on her body. As she bent over the measuring guide he could feel the blood pound in his throat.

She got up, selected a pair from the shelves and handed them to him. He put them on and stood up, stamping on the carpet.

"They feel all right?"

He nodded mutely.

She knelt and felt the shoes. "I used to be a sales girl before. Now I'm the expert on clothing, from tatting lace to tanning leather. These seem to be all right. We'll take an extra pair so you can change. Now let's get some underwear. Come over here to the counter. I'll measure you."

She came up to him and put her arms around him running the tape around his waist and his chest. He was acutely conscious of her nearness, of the round brown arms at his waist, of the scent of soap and of sun-warmed hair rising to his nostrils.

She stepped back, went behind the counter and filled a box with underwear. Then she turned and looked at him critically.

"You'll need shirts, too, that one seems to be a little short in the sleeves. And you'll need a coat, jacket, sweater, clothes for rainy weather . . . oh, lots of things. Some of them will have to wait until later, we can't take everything now. Let me get your sleeve length and neck size."

She took the tape measure and picked up his wrist as impersonally as if it were made of wood. He felt a momentary twinge of annoyance that she could move him so without being affected. The feeling quickly vanished as he realized that a girl as attractive and sophisticated as Marge could scarcely be expected to notice her impact on a raw kid like himself. His mouth twisted slightly as he sneered at his thoughts.

She lifted the tape and put it around his neck, leaning lightly against him as she did so. He could feel his heart hammering from the contact. She glanced at his lips and then looked into his eyes. Her hands continued up with the tape measure, went behind his head and pulled his lips down to hers.

She pulled away from him and he

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found that his hands were on her back restraining her. He jerked them hastily away from the warm flesh, back to his sides. A wave of embarrassment and mortification with his weakness stiffened his body and turned his face red.

She turned back to him and picked up the tape measure again. "I still want your neck size," she said, smiling. He put his traitorous hands behind his back as she lifted her arms to his neck once more.

When she finished her measurement she pointed to a rack of jackets and coats. "Go over there and pick out anything you like while I get some shirts for you."

Roy went over to the rack and looked at the clothes. He stood there, not wanting to take anything until Marge came over. She quickly made several selections and had him try them on. Soon a mound of clothes grew upon the counter as Marge kept bringing them out from the racks. Roy was standing there looking at them doubtfully when she came up behind him, clapped a hat upon his head, eyed it critically and said, "It fits well enough. That should be enough for today. Pick them up and let's go!"

Roy spoke. "You mean, just take them?"

Marge looked at him. "Yes," she said in a tone that dared him to object. She picked up an armful of garments and threw them at him. He caught them automatically. She picked up the boxes and led the way to the car. Roy following her reluctantly.

He put the clothes in the back seat while she locked the door to the building and got in beside her when she returned to the wheel.

"How did you know when I got into town yesterday?" he asked. "Or were you just waiting there."

"We came down to the bridge just a little before you. As I said, we had expected you earlier but when John couldn't see any sign of you on the highway—it's visible with binoculars for a long ways from the roof of the mansion—we just waited until we saw you walking along, then came down to the bridge and picked you up."

"What happened to my rifle?"

"We put it in the gun room. It'll stay there indefinitely; we don't use guns much around here. When you're a member of the group you can have it back."

Roy sat quietly, thinking it over as they drove toward the house. As they came into the hall, John came to the door of the study and looked at them. It seemed to Roy that he had a knowing look in his eye but he only nodded and went back into the room.

They carried the clothes upstairs, Marge coming into his bedroom, oblivious of his attempt to take the boxes from her. She piled the clothes on the bed, opened the closets and began putting them away.

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He stood helplessly by as she filled the drawers and closets. When she had finished she said, "You'll have to clean your own room and make the bed and so forth until you get someone to do it for you. There's cleaning equipment in the closet in the bathroom. We don't have maid service here."

She went to the rumpled bed and fixed it as she talked. "When you're married your wife will do this."

"Which one?" asked Roy, sarcastically.

"Don't get the impression that we like it any better than you do. We were raised in the same society as you were, you know. Sharing a husband with other women isn't our idea of married life either. But if we all have as many children as we can we should be able to readjust the balance of the sexes somewhat and eventually our children will have a more normal life. Here, catch!"

He caught the bathing suit she tossed him. She pointed out the window.

"There's a pool out there. Change and come down for a swim. You'll find most of the others there now. We usually swim for a while every afternoon. It's good exercise and John insists that we all keep as fit as possible." She went out of the room.

Roy put on the trunks and went down to the pool. Almost everyone was there, either splashing about or sunning themselves along the edge.

He jumped in and swam about vigorously, enjoying the cool wetness. He saw Amanda but she was sitting and talking with a group of women so he didn't go near them. He clambered out and stood on the edge, looking at the swimmers.

Marge came by in a revealing bathing suit. He looked at her uncomfortably. She turned toward him and gave him a quick push as she came up. He grabbed out wildly, catching her arm and they both fell in the pool.

She came up beside him laughing, splashed water in his face and swam away. He got out again and, standing well away from the edge, looked about. He saw Stevens sunning himself a few steps away. He went over to him diffidently.

Stevens looked at him from under his upraised arm and turned over.

"Sit down and get some sun," he invited. "I see Marge has taken care of you."

Noting Roy's flush, he added, "In the matter of clothes, I mean."

Roy turned a deeper red. Stevens spoke again. "Nothing like sunshine to make you look and feel healthy. We're all as brown as berries."

"You don't seem to work hard," said Roy.

"You think we should be knocking ourselves out to stay alive, struggling to make ends meet like you did on your farm?"

"It isn't that. I know that you have a lot of food here. But it seems to me

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that there is a lot to be done for the future."

Stevens sat up with a sigh. "Yes—but the future isn't quite the way you seem to have it figured, Roy. There are about twenty of us; there are more than twenty major cities on this planet. You can't maintain a major city all by yourself, can you?

"All of us together can't maintain what there is in just this town. Decay and weathering and accidents of nature, and the attack of growing plants will disrupt it faster than we can hope to fix it. But we can break our hearts and ruin our strength trying—if we lack the courage to admit to ourselves that we must simply abandon it.

"We've got two jobs for the future, and neither one of them has to do with maintaining the things, the buildings and machines and roads, around here—Or anywhere. Our job is to build human beings, and maintain not things, but information—knowledge—understanding for the future.

"Your job isn't maintaining a farm—you were wasting your effort there. Your job is maintaining *understanding of farming*. And that means learning more about it, not merely doing it.

"We can't rebuild a world; it's hopeless and useless to try. We haven't the tool that can do that—but we can build that tool. The tool is a people—a group of human beings, intelligent, educated, and active human beings.

"We've got good stock." Stevens nodded toward the laughing group of women across the pool. "They've got bounce, those girls have. They've all got their laughter back."

He noted Roy's expression. "You think that's easy? It's damned difficult. All of these people here are human beings, they have the same troubles you have. This set-up may look good to you but it has a lot of problems. Not the physical ones you faced—the mental ones, the friction between people. The women don't like to share John with the others. Oh, they're practical enough, they all want children to replace the families they lost, but John has to walk a narrow line so that he doesn't cause any jealousy. The better their mental health, the better their physical health and the better for their children.

"Their babies cause trouble, too. Most of the mothers want to devote all their time to them. At first when we lost so many it was pretty bad. We still raise them on a strict hospital schedule. They nurse them of course, we can't afford to neglect that source—we have to save the canned and powdered milk for those who can't—but we keep them all on schedule so that the routine work gets done. Sadie is in charge of the nursery and she sees to it that they behave. When they get older the children will live with their mothers but it's better now if they are separate.

"So you see, rebuilding a colony isn't as easy as it looks. When you

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are married you'll face the same problems as John does with his wives. It isn't easy not to show preference for the smart and attractive ones over the dull and plain ones. But you'll have to learn it; it will be one of the hardest jobs you've ever tried."

Roy sat there, visualizing the troubles they expected him to meet. The thought of marrying all these strange women repelled him. He would have to leave when his week was up. If he could!

John came out of the house and dived into the pool. Everyone got up from around the pool and plunged in after him. Roy stood watching them until John waved him in, then he joined the crowd in the water. They were playing a game with a big plastic beach ball, Roy getting involved in the game when it was hit toward him.

After a few strenuous minutes the game broke up and they began getting out and going into the house. Roy walked over to Amanda as she came up the ladder out of the pool.

She stood up dripping in a skimpy two-piece bathing suit. She colored slightly under his gaze and said, "Hello. You certainly slept enough."

"I guess I was tired," he replied.

There was a pause. "We really stand out among these brown skins," she said, uneasily.

"You show enough of yours," he pointed out.

"What do you want me to wear, a suit of coveralls? This happens to be more adequate than most, your Marge's for instance."

Roy fell silent under the rebuke.

John came out of the pool near them. He nodded to Roy and took Amanda's arm. "Come on," he said, "I'll race you across the pool."

They swam across the pool together, John cruising a little behind her as she splashed along.

"Winner gets a ducking," he shouted as she reached the other side.

Roy stood watching their horseplay for a moment, Amanda laughing, blooming under John's attention, then turned to Stevens as he passed by, carrying a towel.

"I thought John didn't pay much attention to the women," he said sourly.

"They're to be married tomorrow. They should get to know each other as much as possible before then," Stevens said kindly and went on into the house.

Roy walked slowly after him, his head bowed in thought.

The next morning he was up early. He went down the stairs through the hushed and silent house and out the front door. He stepped back in quickly. The sprinklers were on and the lawn was covered with a fine spray.

He circled through the house and went out a side door. He saw Stevens over by an outlying building and went down a walk between the sprinklers toward him.

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Stevens was kneeling by some lawn mowers examining them.

"They have to be checked once in a while. They're automatic but not to the extent of making their own repairs," he explained.

Roy looked at the building. "What is this?"

"It used to be a stable," Stevens answered. "I know it doesn't look like one but then the government was going all out on this place. They kept horses for their guests. There's a field on the other side. Stretches down to the river."

He led the way through the stables and pointed out the field. "You can't see the river because of the trees but it's way down there. This rail fence runs all the way around it. Eight feet high with eight rails, must be two miles of it."

Roy looked at the fence remembering the rickety one the boar had escaped through.

"The horses are all dead now," Stevens continued. "Odd that they would import breeds to the colonies that weren't all-purpose types but they did. They don't have basic survival types any more. Every animal has been bred for one outstanding characteristic and has lost the basic traits that would enable them to survive in a changed environment. We looked around for animals after we had finished the first search for humans but most of them were dead by then. It would be nice to have milk and fresh eggs once in a while."

"There are some beef cows out around Dad's place," said Roy. "There aren't many though, they don't survive too well without care. I used to hunt them for meat, so they are awfully wild now. But they wouldn't be much good for milk anyway."

"That's the way it is with selective breeding," Stevens replied. "You lose the all-around adaptability of the species."

"There's one adaptable animal that would supply milk if you could find any. Goats. But there aren't many in this part of the country. You could probably find quite a few pigs though. There were a lot of them around and they're a survival type."

"Pigs, eh? We could use some fresh meat."

He turned and they went back through the empty stables toward the house following the walk between the sprinklers.

"Smell that," said Stevens sniffing. "Nothing like the smell of the early morning."

"My father used to say the same thing," said Roy. "He used to take a walk around the near side of the fields every morning. He'd stop at each field and stand there with his hand outstretched and say, 'Be fruitful.' Then he'd step back and sniff and say, 'They smell so good that maybe they will.' They never were though, fruitful I mean."

"Be fruitful?" said Stevens. "Sounds

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like something from the Bible."

"It is. From Genesis. 'And God blessed them, and said unto them: Be fruitful, and multiply, and replenish the earth, and subdue it.'"

Roy walked along, remembering those mornings, seeing them as happy times when he knew where he was and what he was. Life had been so simple then.

"Sounds like it was aimed straight at us," Stevens said. "Here we are, starting the first chapter of a new book, Genesis."

Roy came out of his reverie and looked at him.

"I guess so," he replied thoughtfully, his eyes on the ground.

They reached the house and went in for breakfast. Roy looked around for his sister but didn't see her.

"Where's Amanda?" he asked.

"She's upstairs," Stevens replied. "She's not supposed to see John until the wedding this afternoon."

Roy's face darkened. As they sat down with their plates Stevens laid a hand on his arm. "I know. She's your sister and she's only sixteen, but John's the only one she can marry. She'll have to marry him eventually and she's old enough to bear children now. It may seem hasty to you but Amanda agreed that there was no point in waiting. Women are quite practical in some ways."

"It doesn't seem right," said Roy, doggedly.

"It's right, believe me. It follows from that quotation from Genesis, doesn't it?"

"Yes," Roy replied, "but—"

"But you'll get used to it," Stevens broke in. "When you're married yourself you'll understand it better. Now finish your breakfast and we'll get out of the way so they can get everything ready. We hold the weddings in the study. When we are all in that room it seems like a big affair. We'll have to get you the proper clothes to wear when you give the bride away."

That afternoon Roy found himself standing in the hall as the strains of "Lohengrin" filled the air and Amanda came down the stairs in her bridal gown. She looked so shy and fearful that Roy walked to meet her. He smiled and whispered comfortingly, "You're the prettiest bride ever."

She clung to his arm, he could feel her hand trembling. She looked up at him and said, "You think it's right, don't you, Roy?"

Roy gave the lie all he had. "Of course, Sis. You've just got buck fever. My but that's the prettiest dress I ever saw."

Amanda smiled a little and she seemed calmer as they walked slowly into the study, new and fragrant in its masses of flowers. John and Stevens came in from the other door and met them in front of the small platform at one end of the study. Stevens stepped up on it and began reading the ceremony.

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When it was over John kissed his new bride—his eighteenth, Roy thought wryly—and they all went into the dining room.

They sat down and were each poured a glass of champagne. Roy looked at it dubiously, remembering the fiery stuff he had drunk before. But he didn't see how he could refuse to drink the toast to his sister. He picked up the glass and sipped it. It was quite good, it seemed so pleasant and innocuous compared to his last drink that he drained the glass with relief.

After dinner he drank the numerous toasts proposed, draining his glass each time. Marge, who was sitting beside him pouring, spoke, "Take it easy. You can sip it, you know. That isn't water you're drinking."

Roy smiled at her brilliantly and said, "Who cares?" He slowed down though, aware of a giddiness creeping up on him.

In between toasts he found himself drawn into conversation with Marge. He was telling her about the time one of the pigs had gotten away while they were loading them into the truck one rainy day. He was talking quickly, finding comic aspects to the story as he went along, telling of how his father had emerged from a puddle after a poorly calculated dive after the pig, his teeth startlingly white in a dark-brown, dripping face as he roared unintelligible commands, when he became aware that everyone was

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listening to him, smiling at his story. He broke off abruptly and flushed.

There was a pause all around the table and then conversation resumed.

Marge said, "Finish your glass and come on. We're having a dance. That is, if you can walk."

Roy looked at her, offended, drained his glass and got up quickly. He almost fell. He clung to the back of the chair, his head spinning. When he had steadied somewhat, he giggled and, leaning on Marge, went with her to the ballroom.

"I can't dance you know," he said, bending toward her ear. "Amanda used to make me dance with her sometimes but I never liked it."

"Don't worry about it. You'll learn," Marge replied.

When Roy didn't answer she looked up at him. He shifted his gaze from her ear which he had been regarding closely; slowly being overcome with a desire to bite it, and smiled at her warmly.

Marge smiled back. "I must say that you seem to be more human with a few drinks in you. You've been a bit stuffy so far."

She led him to the record player, switched it on and turned to him, her arms lifted. Roy grasped her awkwardly and started stumbling about. Under Marge's guidance he soon caught the rhythm and found himself dancing with an ease he hadn't known he possessed. His feet behaved much better if he kept moving.

He went from partner to partner after that, interrupted occasionally by people shoving a glass in his hand and proposing a toast. He drank them all, even the one to pigs which seemed out of place somehow.

He awoke the next morning, trying to push away the arm that was shaking him. He opened his eyes blearily, conscious of a terrific thirst. Marge was bending over him, wearing a bathing suit.

"Come on," she said. "You can't sleep all day."

He started up guiltily and sank back as he realized he was naked.

"Who undressed me?" he asked, afraid of the answer.

Marge grinned at him wickedly. "Wouldn't you like to know?" she taunted. "Here, take these pills and drink this."

She gave him a couple of pills and a small glass of dark brown liquid. He took them, making a face at the bitter taste of the medicine in the glass.

Marge threw him his trunks. "Get into these and meet me outside your door. Don't drink any water."

Roy got up after she went out and went to the bathroom. He had to have some water no matter what she said. He came out again, humming a song. He looked at his bathing trunks on the floor and shuddered. No swimming for him, he was going back to sleep. He went to the door, resolved to lock it and keep the busybodies out. He was

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leaning against the door fumbling for the lock when it opened and Marge came in. He made a wild dive for the bed and pulled the covers over him.

Marge came toward him, picked up the trunks and threw them on the bed. "Put them on," she said grimly.

"O.K. Go on out and I'll do it."

"Oh, no! You're getting too sneaky. Put them on under the covers."

Roy smiled weakly but made no move.

Marge grasped the covers. "You want me to pull them off?"

"No! I'll get them on."

Roy thrashed about beneath the covers under Marge's amused but watchful eyes and emerged in the trunks. Marge took his hand and led him down the stairs and out the front door. He tried to hold back when he saw the sprinklers going but she held his hand tightly and pulled him into a run, dragging him into the midst of the spray. He closed his eyes against the water and ran along beside her around the wing of the house. Suddenly she increased the pace and they shot out of the spray. Before Roy could slow down they were in the pool.

He looked at her accusingly. She smiled and said, "Best way to get rid of a hangover I know. Swim a bit now and we'll go into breakfast."

Roy continued to look at her.

She became alarmed and started to swim away but she was too late. Roy caught her and shoved her under, pushing with his feet to put her way down. When she came up he was swimming on his back spurting water from his mouth.

"What was the idea of that?" she asked indignantly. "I was just doing you a favor."

Roy paddled about spurting water upward and regarding her owlishly.

"You didn't take a drink of water, did you?" she asked suspiciously.

"Just one glass," Roy answered. "It feels so good on my tongue."

"Drunk again. Well, you'll have to sober up by yourself. Come and eat when you're ready."

She swam to the edge and started to get out. He grabbed her and pulled her back in.

"Old amorous Slater," she said when she came up. "A few drinks and he loves everybody."

She took a deep breath and dived under the water, swimming farther down the length of the pool. She looked back through the clear bluish water and saw him coming after her. She went toward the ladder and started out. She clung to it as he caught her again. She tried to push him off with her legs and one hand but he hung on.

"All right then," she said.

She let go and grabbed his head, kissing him as they went under. When he came up she grabbed him and kissed him again. He started to swim away but she caught him and kissed him once more.

"Ready for breakfast?" she asked.

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"Or do you want more?"

Roy started to shake his head, then grinned and kissed her.

"I give up," she said helplessly. "You're a regular wolf when you're in your cups. But we have to eat on time or breakfast will be cold."

Roy agreed. He helped her out and they went up to their rooms.

When Roy came down again he realized he felt much better. He was still thirsty but his head was clear. He went into breakfast. Everybody looked up as he entered, smiling broadly at him. He smiled back shamefacedly, feeling the friendliness of the grins. He didn't see his sister or John among them and as he seated himself beside Stevens, he asked, "Where's Sis?"

"She's with her husband. They're having breakfast in their room," Stevens replied. "How's the head? You really had a skinful by the time I put you to bed last night."

"You put me to bed? I thought . . . The head's fine, Marge dragged me into the pool and I feel pretty good."

"Marge knows a lot about men."

"She seems to be assigned to look out for me. Or is it her own idea?".

"A little of both, I guess. She wants children, feels a little out of place among all the mothers."

"I remember John said she and Sally hadn't had any children."

"Marge was married and had a baby boy before the plague. She and John just aren't compatible I guess. But she doesn't talk about her past life very much and we don't ask. I'm sure John knows, he has complete records on all of us to find out what we know and can do to contribute to the group but he doesn't talk about anyone's past."

"By the way," Stevens continued after a pause, "I've been thinking about pigs. We've devoted most of our time up to now searching for survivors. We looked over all the towns within a reasonable distance and we were finishing up the outlying sections when we found you and your sister. It's time we started on a future meat supply. We could raise pigs in that field I showed you, couldn't we?"

"If you made that fence a little tighter and set a separate enclosure for boars, it would be perfect. But where would you get pigs?"

"I've been checking the records down at the slaughterhouse. I thought we could look around the farms of all the big shippers of pigs and see if we couldn't round up some."

"Catching wild pigs is pretty difficult. But I wouldn't look for the farms of the big shippers. They had their pigs on a mass production basis. The pigs would be fenced in so well that they couldn't get out and they probably died soon after their owners. The pigs that would stand the best chance of surviving are the ones who were owned by small farmers, like my

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father was. They roamed fairly freely, ate slops and whatever else they could find and the fences weren't nearly as good. I know that personally."

"I never thought of that. I'll check the records today. We'll probably organize a hunting expedition soon. Care to come along?"

"I'd be glad to. I feel sort of useless around here anyhow."

"If we find any pigs you'll be invaluable. None of us knows much about them. I'm sure that someone has studied the subject but reading isn't nearly as good as firsthand knowledge."

"All of you seem to be so self-sufficient and accomplished. I didn't think that I was good for anything except . . . well, an extra husband."

"I admit that you may not have the education that some of us have, but you've read quite a bit so there's no reason why you can't acquire more knowledge. In fact John will probably insist that you do."

"Reading was about my only amusement on the farm. But I've read everything there at least twice."

"We've a huge library here. The government installed it and most of the books hadn't even been opened when we came here. But you certainly should be able to find something you haven't read."

"I think I'll look it over. Where is it?"

"It's down the hall, next to the study. Read anything you like but put it back where you got it. We like to keep the books where we can find them when we want to look something up."

Roy finished breakfast and went into the library. He looked over the rows of books and was soon immersed in a novel. He read for a while but a sense of uneasiness kept gnawing at him. He felt that he should be doing something instead of sitting here in the middle of the morning reading a book. He put the book down.

There must be something he could do. But what? If they got some pigs, he'd have something to do. Suddenly he realized that he was thinking in terms of living here. His original intention in coming here, getting Amanda back, seemed childish now. He thought of the farm with distaste. Back to that life again, scrabbling for food in that drab spot, it was unthinkable. Here he felt at home, he remembered the smiles he had drawn this morning. They had been friendly and understanding. He smiled to himself and then stiffened in dismay. He'd have to marry!

He tried to summon up what he knew about marriage. It was very little. Oh, he knew the facts of life, he'd been raised on a farm, but marriage seemed to be something more than that. There had never been a woman in the house since his mother died when he was a child. His father had felt that you married once and

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then for life. Here he was contemplating marrying a whole harem.

He sat there viewing the subject with apprehension. He didn't want to leave here but it looked like he must. Then he knew that he couldn't leave even if he tried. They wouldn't let him.

In moments of stress like this his father had always picked up the Bible. He started to get up to find one and then remembered what Stevens had said about that quotation from Genesis: "Sounds like it was aimed straight at us." He smiled wryly. It looked like he had to do it. It was his duty to get married. At least he wouldn't be as bad as Solomon who had had seven hundred wives and three hundred concubines, whatever they were.

Before he got involved in marriage he'd better find out something about it. He went out in the hall to ask Stevens about some books on the subject. Amanda was coming down the stairs.

"Hello," said Roy, eying her critically. She didn't look any different, maybe prettier with her blushes.

Amanda recovered her poise somewhat. "Hello. How are you this morning?"

"Just fine. And yourself?"

"In the best of health," she replied looking at him with a sophisticated air.

Roy turned abruptly and went back into the library. Amanda patronizing him! He'd have to find out what marriage was about for himself. He started looking over the books on the shelves.

He was deep in a volume entitled "Married Love" when Marge came looking for him. She walked quietly over to him and bent down to see the title. Roy lifted his eyes unwillingly from the page and met her amused glance. He blushed to the roots of his hair and jumped up. She waved him back into the chair and went out, closing the door behind her.

Roy moved his chair over to the window so that its back would be to the door. Then he sat down again, picking up where he had left off.

He had been reading for a short while when he realized there was someone sitting beside him. He started and looked up to see John smoking quietly in a nearby chair. He flushed and put down the book but John continued to look out the window.

"You've made up your mind to stay?" he asked.

"I was just trying to find out what—" Roy broke off, embarrassed.

"A good attitude, looking things up in books. But I don't think it will be of much help on the subject of marriage. However, I see that you realize what it means for you to stay here. Not that you have any real choice in the matter. You know that?"

"Yes, I know."

"You know that you will be a conjoint husband, with me as your associate?"

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Roy nodded.

John stood up and went to the window. "It isn't a nice situation that you are in, especially with your background. You will marry all of the women here with the exception of Sadie and your sister. You will marry Alice when she grows up, she will be your only real bride since all the others have been married. But there isn't anything to be done about it. None of us like the situation. I didn't want to marry your sister you know. She's very young and it would have been better for her to have a chance to get used to the idea; a chance to grow up a bit without the troubles of motherhood for a while. But there's not much choice for any of us." His face was bitter as he turned to Roy.

Roy looked at him in astonishment. John felt the same way about it as he did. He thought for a moment.

"I saw her this morning and she seems to be cheerful enough," he said.

John looked at him sharply and then grinned. "I imagine you'll have to grow up a bit, too."

"Now the way we will work it is for each of us to father alternate sets of children with our mutual wives. They should be able to have a child every year. That means that in twenty years, if all goes well, we'll have over three hundred and sixty children!" John's face lit up at the thought of so many people.

Roy was shocked. "A child every year! That's too much, isn't it? I never heard of anyone having twenty children. Isn't it bad for the mother?"

"There are records of women having twenty children, usually they were from the poorer classes. It hasn't ever been done among the families that could afford good care and where the mothers were carefully kept in condition for breeding. I don't see why we can't do it. Maybe some of them will have to have more time between pregnancies. But we want as many babies as possible."

Roy looked at him, dazed. "Then if I have seventeen wives, eighteen with Alice, every other year, at the end of that time I'll have one hundred and eighty children."

"More or less. Don't forget that our children will marry and have children, too. After about fifteen years the first group will marry, the next year, another group and so on. If they are all fertile, we'll have eighteen more children from the first group. The next year we'll have thirty-six more when the second group mates, plus our own children every year of course."

Roy shook his head. "It sounds like a lot of kids. The relationships between them all will be horribly complicated."

"It's not that bad. Each child will have his mother's and his father's name. He won't marry anyone with the same name. But our immediate work is clear; we have to start the next generation.

"You'll marry all the women here.

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as fast as possible, all those that aren't pregnant. You will marry those when they have recovered from delivering my children. I will take the ones you've married back when they've recovered from bearing your children. I can see that we will have to have a check-sheet of some kind. But that comes later. Any objections to getting married this afternoon?"

Roy quailed at the thought but he said, "No."

"It may be this evening before we get everything ready. You will marry Marge first. You know her pretty well and she's suited to start you on your polygamous life. I'll see about the wedding preparations and tell her to get ready."

He went to the door and called, "Marge!"

Marge came in and he said, "Meet your future husband. You're getting married this evening."

"My wedding day! But I'm not supposed to see him."

"You already have so we'll waive it. Go cheer him up." John went out the door.

Marge came over to Roy and looked at him appraisingly. "You're pretty ugly and pretty young but I guess you'll have to do."

She sat down in his lap. "Don't look so hurt, haven't you ever been teased? You've an awful lot to learn."

She put her arms around his neck and kissed him. "The first thing for you to learn is how to kiss. You do it this way." She demonstrated again.

Roy emerged from his lesson after a bit and they left to get dressed for the wedding.

When evening came Roy found himself standing before Stevens as he read the marriage lines, this time as the bridegroom. He said his "I do," and kissed his bride remembering what he had been taught. Marge smiles at him and whispered, "Well done." He colored slightly and she added, "Don't look so serious. This is a joyful occasion."

It was, for everyone but Roy. He drank the toast to the bride automatically, his mind full of apprehensions. He scarcely noticed Marge limiting the number of his drinks, judging him with an experienced eye.

They went in and danced for a while until Marge said, "It's time for us to go."

They walked out into the hall and headed for the stairs. Roy, almost in panic, said, "You go ahead. I want to get something."

She turned to him and said, after a pause, "All right. I'll expect you in ten minutes."

He turned and bolted into the library. He closed the door and leaned against it, thinking of what he could do to delay the events that seemed to be rushing him along. He went to the shelves and got a book.

He found it difficult to concentrate even though the subject interested

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him. After a few minutes he heard a step and saw John coming toward him.

John glanced at the book. "Giving your bride a little time to get ready?"

"Uh . . . yes," Roy replied confusedly.

John put his hand on Roy's shoulder and smiled. "What's the matter? Things going too fast to suit you?"

Roy nodded his head and looked at John appealingly.

"Nothing to worry about," John said. "Now go on up. Take your book with you if you like."

Roy got up slowly and went to the stairs. He stopped there, reluctant to take the first step.

"Go ahead," John urged.

John watched him go up the stairs and went back to the ballroom, smiling. "I think Marge is going to be surprised when he walks in," he said to himself. "I don't imagine she's expecting her bridegroom to come in carrying a book on the care and breeding of pigs."

THE END

IN TIMES TO COME

This time, this column should, perhaps, be headed "In Times That Came," or some such. Our next issue will be the January, 1955 Astounding.

I was a sophomore at M.I.T. in January, 1930, and I'd just sold my first science-fiction story, when I discovered a brand new science-fiction magazine on the stands—Astounding Tales of Super Science, for January, 1930. One quarter of a century ago, the magazine that, through various developments and evolvements has become Astounding Science Fiction of today, first appeared.

The recent October, 1954 issue of this magazine represented twenty-one years of continuous monthly publication by Street & Smith. The January 1955 cover will be our Christmas cover—since it comes on the stands in late December—and it happens that the January, 1938 cover was the first that I bought for this magazine as editor. Time is curiously non-linear; it seems very short when you look back, seems long and slow when it's here, and enormously diffuse and distant in the future. But . . . it is a quarter century, none the less!

Birthdays are peculiar; they're simply days, after all. A human being, on reaching twenty-one, quite arbitrarily and abruptly acquires certain new rights and duties. Yet is he abruptly different in nature?

How can a magazine celebrate a quarter century? By withholding some particularly good stories as they come in, to splurge on one issue? It seems rather pointless. There'll be nothing super-special about the January, 1955 Astounding—a run-of-the-mill issue, let's say.

What really counts, after all, is to make the mill run the best darned product, all year round, that we possibly can.

And that we do!

THE EDITOR.

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SCANNING AND FORM

BY RICHARD C. PINKERTON

Take a look at the wheels on a passing automobile. When it's halfway down the block, you see the wheels as round — but you know the image in your eye must be elliptical! How is that neat trick worked . . . . ?

How is it that we recognize a square as being "square"? This question is not an easy one to answer. It is linked to some very basic problems in human perception which are far from being solved even today. Such problems first captured the interest of Ernst Mach in 1886. Being a physicist, Mach was struck by the fact that we apparently do not perceive forms in the same way that we treat them geometrically. Take a square and tilt it 45° around its center. Now it is no longer a square—it's a diamond. Psychologically it is a different figure. Not only that, the size has somehow been increased. We tend to measure distances horizontally and vertically. Now the diagonals are singled out for appraisal rather than the edges.

Many other people, after Mach, became interested in these problems. The term "Gestalten" was heard ever more frequently. Today this word has taken on a huge jumble of meanings besides the simple one. ("Gestalt" means just "form" in everyday German.) Yet in a way, the whole field of Gestalt psychology had its beginning when someone asked the simple question: What is a square?

Being biased by our mathematical training, we are apt to analyze the property of squareness in geometric terms. We start out by listing certain properties. A square is made of straight-line segments. There are four of these. The segments are all of the same length. The angles made by them are all equal—they are all right-angles.

Does the mind actually wade through any such process as this in order to identify a square? A child can recognize one in a fraction of a second. It is

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known from experiments in animal psychology that even rats can distinguish between elementary forms. Apparently they are able to do this without any help from Euclid. Anyway, consider a more complex form. The letter "k" is recognized just as easily as a square, at least after a few practice exposures. The lines and curves which make up our printed letters defy any simple geometric analysis. Yet people can read over five hundred fifty words per minute. An average reading speed has been given as two hundred seventy-one words or one thousand four hundred forty-nine printed characters per minute. This means the partial identification of at least one letter every 0.04 second on the average.* Take another case. How many corners and curves do you single out when you recognize a B-29 or a Model A Ford? There must be some shorter mental process used for common visual identifications.

There are some people who object violently to making "mind-machine" analogies. But building a machine to duplicate this human activity might help to unravel some of these biological mysteries.

* These data are from Luckiesh and Moss, "Reading as a Visual Task," p. 312, D. Van Nostrand & Company, New York, 1942.
These statements should be qualified by saying that the identification is probably *not* made on the basis of single-letters or words. It is not necessary to take in the entire configurational content of each letter. We tend to read in groups of words. Furthermore, according to some estimates we could skip over half the letters in English words and still get the full meaning. In terms of Information Theory, our language is over fifty per cent redundant. Even so, our optical system operates at a remarkable speed.

As a matter of fact, the first attempts to build such a machine were made sometime ago. They were made for quite utilitarian reasons. It would be a fine thing to have machines which could read books to the blind — the ordinary books which appear on our library shelves. As helpful as they have proven, books printed in Braille or other kinds of raised symbols are very expensive and the subject matter limited. The speed of comprehension cannot approach that of ordinary reading. A reading aid called the Fournier-D'Albe Optophone was first described in the Proceedings of the Royal Society in 1914. It was designed to translate printed type into recognizable musical chords. However, there is a simpler scheme for mechanical recognition which I should like to describe first in order to show just what kind of a problem is before us.

Suppose we wanted to identify some particular letter, say the letter "H". One way to do it would be to cut the form of an "H" in an opaque screen. Behind the screen might be placed a photoelectric cell connected to a meter or some other indicating device. Then the shadows of various letters would be cast on the screen by placing cardboard models of the letters between the screen and a light source (Figure 1). When the shadow of the letter completely covered the hole, no light would pass through. Identification of the letter would occur when no cur-

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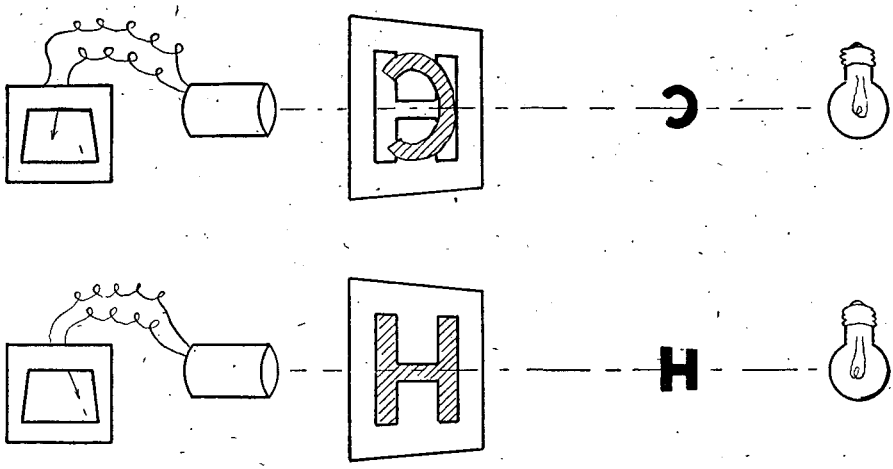

Figure 1. A Simple Scheme for the Recognition of Letters.
Here is shown identification and non-identification of the letter "H". Identification occurs when no current registers on the meter.

rent registered on the meter.*

There are several difficulties connected with this scheme. First of all the test letter must be squarely positioned in the center of the screen. It must not be shifted or tilted. In addition, the style and size of the letter models used must be uniform. A truely useful mechanical reader should be able to operate whether the printed type style is 12 point pica, 5 point pearl, **Roman Boldface** or *Italic*.

It would be naïve to assume that the brain works in a similar fashion, which is the reason I brought it up in the first place. The brain probably does *not* have little images of remembered forms, built up of its nerve cells or stamped on its fibers. A good argument against such an arrangement is that it is not *size invariant*. We do know that the brain operates with nerve impulses, quasi-electrical in character. Perhaps the patterns are to be sought in the time sequences of these impulses, which do not have any material existence at all.

The Fournier-D'Albe system uses a different method of scanning. The scanning mechanism has been used in conjunction with an electronic analyzer which does the actual work of recognition. What is important is the form in which information is fed into the analyzer. In this system, a light-sensitive probe is moved from left to

* A device of this sort has been described in U. S. Patent 2,228,782 by A. R. Sharples, 1941.

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right over a line of type. The probe has a vertical slit-shaped opening. As this opening passes over a letter, various areas of the slit are momentarily darkened. In one design the slit is divided into five bands. This is illustrated in Figure 2. The sampling of a letter at these five different heights is usually sufficient to identify it.

The patterns of alternating light and dark which pass beneath the five eyes of the probe are converted into electrical impulses in separate channels. These pulses are shown in graphic form with time plotted out as the "x" coördinate. They have a distinct pattern all their own. I suppose it would be most proper to call them configurations in the time domain. For simplicity, I'll just call them pulse trains.

From this point on a number of things might be done. The pulses may be converted directly into musical tones. The circuits necessary to do this are not complicated and a reading aid designed along these lines is compact, portable and relatively inexpensive. On the other hand, the reader doesn't hear anything like the letter picked up by the probe. Instead he has to learn a whole new code to replace the familiar vocalized sounds originally implied by the letters.

Another solution is to send the pulses to an analyzer which will actually distinguish between the letters. This consists of a fairly complicated system of relays much like those present in a telephone exchange—a little too complicated to present here. If the pulses arrive in the right sequence, a particular letter is identified. Its "number" has been dialed. Once we have the right party on the line the instructions may be passed on to a vocalizing device. The sound of the letter or a reasonable facsimile would be pronounced over a loud-speaker. Bell Telephone Laboratories have a machine called the voder which can do just this. If the original printed material is spelled phonetically, the machine will laboriously produce a rough approximation of the words. However, by adding all the extra relays and wiring for these identifica-

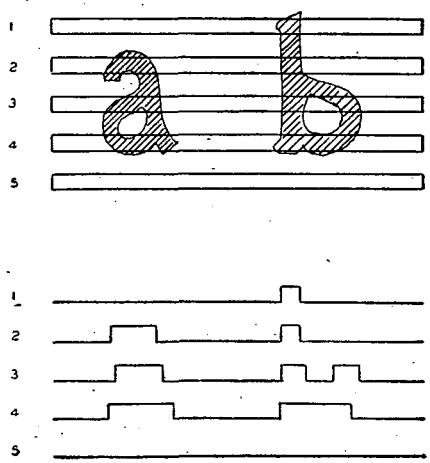

Figure 2. The Principle of the Fournier D'Albe Optophone.

In one form of this device, the letters are scanned at five different heights. The output then appears as electrical pulses in five separate channels.

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tion circuits the size and cost have been increased enormously.

This whole system suffers greatly from the same problems of alignment which plagued the first scheme considered. If the probe is placed too high on a line of print, material which should have been fed into Channel Two will show up in channels Three or Four. The machine will start to babble or stubbornly refuse to say anything at all. Here we have a kind of mechanical aphasia. In order for it to perform properly the printed type has to be uniform. Even a type style with a few extra curlicues would cause trouble. The size of the analyzer section would have to be increased twofold just to handle capital and small letters —even letters like "o," "w" and "c" which have the same form in both cases.

Ideally, what we need is a scanning system which would save all this extra work for the analyzer. Such a system should be able to pick up a figure in any haphazard orientation, regardless of size or exact position, and send out the same train of pulses in any situation.

Leaving the problem of the reading aid, let's look at the workings of a TV camera. The essential part of the camera is a tube called the iconoscope. It has a screen containing thousands of light sensitive spots, on which the picture is focused. Now the electrical output from these centers cannot be

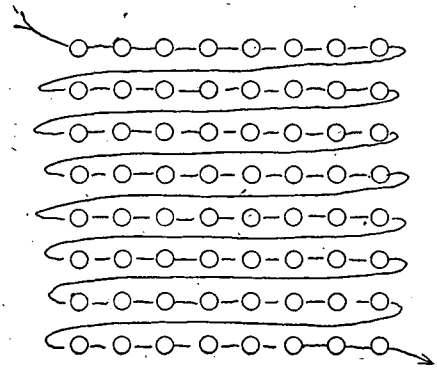

Figure 3. Simple Horizontal Sweep Scanning in a Checkerboard Field.

sent all at once over as many thousands of TV channels. Instead, the field is scanned by taking the output of one center at a time, all very rapidly. Commercial TV uses an interlaced system of scanning in which first the odd and then the even numbered rows of points are covered. The electron beam, which acts as the probe in this case, asks the following question of each spot: Are you receiving any light? If the answer is yes, a tiny pip shows up in the pulse train. How does this sequence of pulses appear when the TV camera has a square figure in view?

Let's set up a much simpler sort of screen. Suppose we take a bank of sixty-four photoelectric cells arranged in an 8×8 pattern like a checkerboard. The cells will be scanned in rows from left to right, taking the rows from top to bottom as in ordinary reading. There is nothing particularly basic

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about this order. Readers of Chinese or Hebrew might pick a different one. This sequence of scanning is shown in Figure 3. Now suppose the figure of a square is projected on the center of this screen. If the square is about four units by four in size, the pulse train will appear as in Figure 4a. The outputs of the first two rows of cells would show no effect. Then in the third row, four cells in succession would be tripped, indicating the top of the square. Following this would appear two pairs of pips corresponding to the vertical sides. Finally, in the fifth row there would be another sequence of four to complete the bottom of the square.

Next suppose that the square is shifted from the center of this network of cells. The square in Figure 4b has been lowered one unit and shifted one to the right. The pips in the pulse train have now been shifted nine units in time to the right. However, their fundamental pattern has not been changed. It would still be easy for an analyzer to recognize this pattern as corresponding to a square.

Using this type of scanning order is one way of handling the problem of alignment. However, if the size of the square is changed the trouble starts all over again. The number of pips corresponding to the top and bottom of the square will be changed—that is, they will take up more time in the pulse train. The time interval between

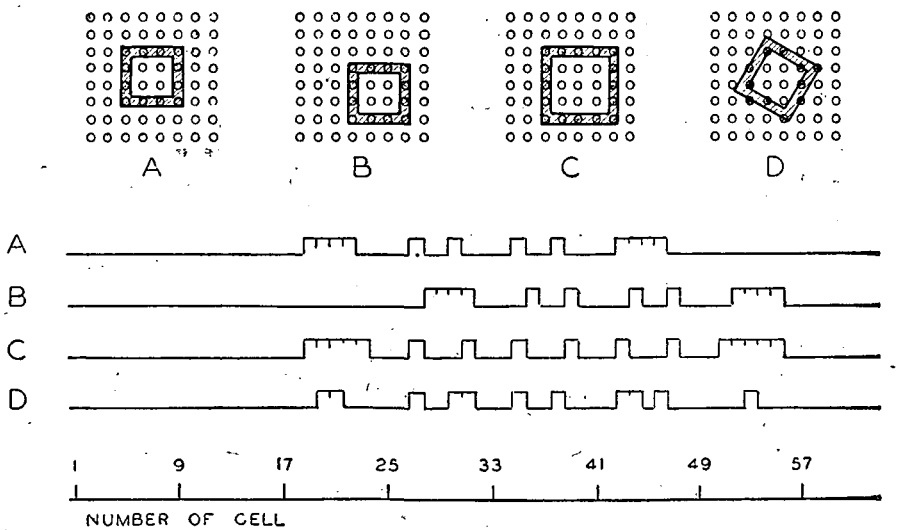

Figure 4. Pulse Trains of the Figure of a Square in Horizontal Sweep Scanning.

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the pairs of pips indicating the sides will be altered and the number of pairs changed (Figure 4c). This means that a different recognition circuit must be installed for every size of square which we wish to identify.

As far as the psychology of this embryo optical system is concerned, every square seems to have a distinct form all its own. There is only one compensating feature. It is now possible to get some idea of the size of the object. But it would be far better if the concepts of size and form were kept well separated at this stage of development. It would not do to have objects in the environment which took on different natures as they got closer or further away. It would be simpler to build a separate scanning system for the purpose of measurement—say a pair of elements which would take in the horizontal and vertical dimensions of an object and feed this into the analyzer as special information.

If the projection of the square is tilted slightly on the screen, the pulse train is drastically altered (Figure 4d). The analyzer section is going to have a particularly nasty job of unscrambling to do. None of the former characteristics may be picked out. The pips do occur in pairs, but this would be the case for any simple closed curve focused on the screen. The time intervals between them are no longer uniform. The problem of constructing extra recognition circuits to handle all cases of rotation is getting painful.

These problems can be eliminated by choosing a different type of scanning pattern. Instead of the horizontal sweep arrangement, the proper geometric curve seems to be the spiral. Spiral scanning has been proposed for use in television. It is well suited to round picture tubes, where all of the sensitive surface may be covered. There are some practical reasons why it has not been adapted for commercial television. With spiral scanning, pictures would appear brighter and have better resolution in the center. They would be blurred and darker on the outer circumference, where the electron beam swept over its path too rapidly. As in the human eye, the resolving power would not be good in peripheral vision.* In spite of all this, spiral scanning offers an ideal solution to the problem at hand—namely building a machine which can perceive form.

There are two common types of spiral, the Archimedean and the logarithmic. In the Archimedean spiral, the distance from the trace to the center becomes uniformly greater as the number of turns increases. A logarithmic spiral is shown in Figure 5. The distance from the center becomes disproportionately larger as you wind out of the spiral. The Archimedean

* Of course, there may be an entirely different reason for this. Some physiologist might point out that there are different proportions of rods and cones along the edges of the retina. But this leaves us with the problem of explaining what evolutionary forces were at work in creating such an arrangement.

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form is the one once proposed for TV scanning. But the logarithmic spiral is found more commonly in nature, for example in snail's shells. D'Arcy Thompson has collected numerous instances of this in his famous book on growth and form.*

A square superimposed on a logarithmic spiral is shown in Figure 5. In this system of scanning, you may think of the photoelectric cells as being scattered throughout the field but roughly distributed along the lines of the spiral. They are being scanned so that the number of turns per second made around the center is constant. The pulse train resulting from this type of scanning is shown below the figure. The remarkable feature is this: If the square is properly centered on the screen, its size and angular position have very little effect on the pattern of pulses which results. The only major change is that the sequence is shifted uniformly in time.* This means that the job of the analyzer is enormously simplified. There is now only one "number" which need be dialed in order for the switchboard to see a square. Of course the square—

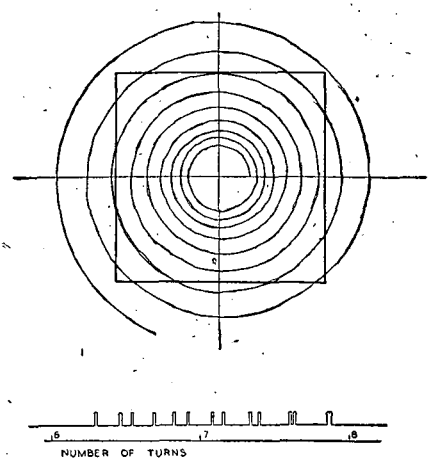

Figure 5. Scanning with the Logarithmic Spiral, Showing the Pulse Train for a Square Figure.

* For those who remember their analytic geometry, the following characteristics of the logarithmic spiral may prove interesting. They show why it is very well adapted to certain applications.

A general equation for the logarithmic spiral is $\log r = \log a + b\theta$, written in polar coördinates. The distance "r" shows how far it is to the center of the system. The angle "θ" gives the number of turns necessary to reach this distance along the spiral, starting from some preassigned distance "a". The constant "b" is a sort of pitch index, showing how loose or tight the spiral is. A large value of "b" means that the spiral will unwind very fast, that is, that "r" will get large after only a few turns around the center.

Suppose that we have two points on a certain figure which intersects the spiral at distances r(1) and r(2). Now suppose that the figure is enlarged, so that the corresponding points appear at larger distances "r". If the new figure is similar to the old one, that is, if it has not changed its shape, the ratio r(1)/r(2) will not have changed at all. According to the equation, $\log r(1)/r(2) = b[\theta(1) - \theta(2)]$. This means that, although both r(1) and r(2) have increased, the angular distance required to pass from one point to the other along the spiral has remained the same. If we scan with "θ" increasing at a uniform rate, the pulse trains corresponding to similar figures will remain pretty much the same.

Now consider all the logarithmic spirals which have the same pitch "b" but different values of "a". These form a family of curves which interleaf with one another without crossing, and which fill in the entire field. Now if we draw another family of curves which intersect these at right angles, we get another set of logarithmic spirals. However, they now unwind in the opposite sense. If the first family are very tight spirals, the new family will be loose. In fact, the pitch will be $-1/b$. The two families form a so-called orthonormal set of coördinates which can then be used themselves to locate any point in the field. This is a property which is mathematically very desirable. When the pitch "b" becomes very small, the first family is transformed into a group of concentric circles while the second family becomes the radial lines passing through the common center. In other words, the familiar polar coördinates are a special case of logarithmic spirals.

* There is one other effect—a slight dependence on the phase of the angle. This may be seen by the fact that when the spiral first intersects the side of the square it may merely graze it or it may cross it at two points having varying degrees of separation. This effect is easily smoothed out in the analyzer or may be minimized by using a spiral scanning pattern which rotates very rapidly itself.

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or any other figure—must now be centered in the field. But it is quite possible to build additional apparatus to perform this function. Acting like a gun pointer or the head of a guided missile, its job would be to direct the eye of this mechanical viewer on the object in question. Nature seems to have put us to shame on this score as well. The jumping spider has this part of the problem solved to perfection. Granted that he has had a few more millions of years to work on it than we have, he still packs his aiming apparatus in a fantastically small space.

The use of this type of scanning is not limited to square figures—in fact it makes no difference what form is being viewed. Once the pulse train sequence of any arbitrary form is keyed into the analyzer section this form may be identified regardless of its size, complexity or orientation.

As far as human perception is concerned, this property of invariance under rotation is not inborn. As Mach pointed out, a square tilted through 45° seems like a different figure. But we apparently do train the ability to perform mental rotations. How is it that some people have more ability than others to fit the pieces in a jigsaw puzzle? This seems to be an ideal psychological testing gadget.

The machine we have been discussing is a purely hypothetical one as far as I know. What evidence is there that any of these factors enter into human perception? It is quite impossible to isolate mechanisms as complicated as these in living organisms. Neurologists attempting to trace the optical connections in animals even as simple as insects have long ago given up in despair. But every now and then some clue turns up which seems significant.

For some time it has been suspected that a scanning mechanism was tied up with human vision. W. Grey Walter has presented some very convincing arguments in his fascinating book, "The Living Brain." Scanning is somehow connected with the alpha rhythms of the brain, detected with the electroencephalograph. When the eyes are open, the alpha rhythms diminish in intensity. When the eyes are shut, they increase. Direct connection of the sensitive centers in the eye to the appropriate parts of the brain along individual nerve fibers would be impractical. According to Sir Charles Sherrington, there are over 137 million light sensitive elements in the human eye. The number of neural connections is thinned out to a little over a million by the time the brain is reached.* Now when there are fewer channels than are necessary to conduct all the information required, the obvious solution is to use scanning. My guess is that there are a good many scanning patterns, each one for some specially developed purpose.

It is known that under certain conditions the data coming from our

* "Man on his Nature," p. 119.

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various senses get mixed up so that there is a kind of interference. This has been compared to "cross talk" in telephone circuits. Zietz once did some experiments to see if there was any effect of sound on visual afterimages. Describing the results, Hartmann says that a vibrating tone caused the image to flicker. With a low pitched sound, the contours tended to vanish. With an intermediate pitch, the contours were sharper. But for a high tone, a rounded afterimage tended to become squarish in form.

Here are some curiously related properties of the spiral scanning system. In our mechanical viewer, the circle gives the simplest pulse train. Since it intersects the spiral only once, there will be only one pulse in the sequence. (The circle is also what the psychologists refer to as a strong gestalt. By this they mean, among other things, that if we perceive a rather complex figure only partially, we tend to imagine it as having the form of a circle.) The more angular and jagged a form is, the more times it will intersect the scanning spiral. Of the regular polygons, the triangle will give the most pulses, followed by the square and so on until a further increase in the number of sides causes them to approximate the circular form. Now if extraneous pulses are inserted in the scanning train—as may occur in noisy circuits—the analyzer would interpret the figure as having more detail than was actually present. It might well take on a "sharper" form, to use a somewhat ambiguous term. A circle might even turn into a square!

Finally, there is a group of experiments described rather strikingly in Mr. Walter's book. A strong, rapidly flickering light is shone in the closed eyes of some subject. The light must be strong enough to pass through the lids because closing the eyes seems to be necessary to turn on this particular effect. This produces some startling results. Usually the subject sees brilliant patterns of all sorts. A frequency of ten per second causes some people to see whirling spirals, whirlpools and Catherine wheels!

Scanning and form are apparently intimately connected. Whether or not we use these same mechanisms in our own visual perception, the proper scanning technique may simplify immensely the processes of recognition and identification.

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THE END

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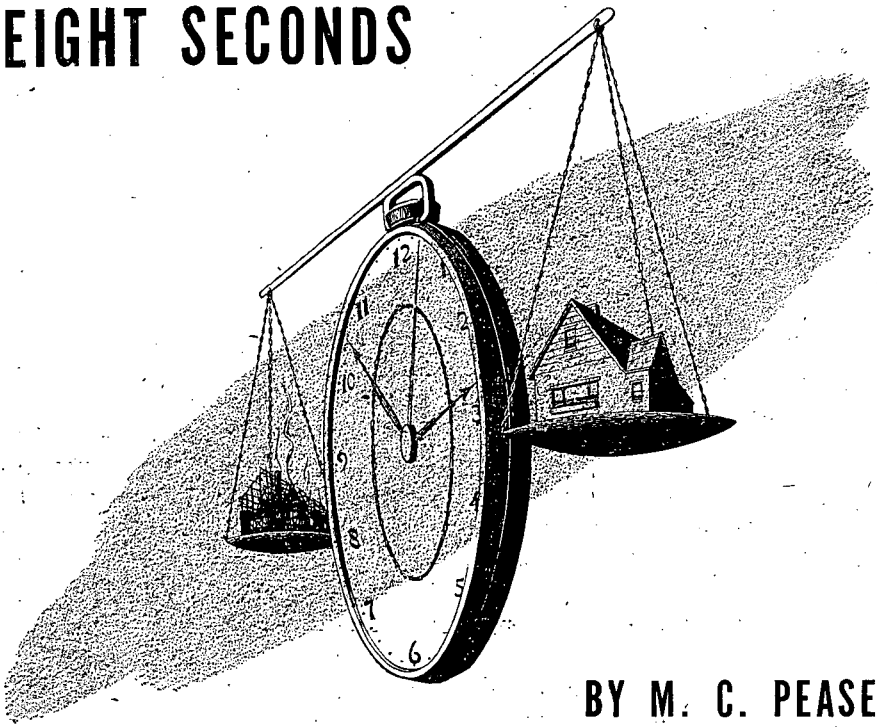
EIGHT SECONDS



BY M. C. PEASE

Sometimes it's quite useless to reach the right conclusion. For instance, if you get the right answer eight seconds too late . . .

Illustrated by van Dongen

The General looked only moderately impressive as he took his seat at the head of the table. He looked competent, holding himself with the assurance of authority, but he did not look brilliant.

"Gentlemen," he said, after his eyes had measured the officers facing him, "we have a problem. It is a very simple problem — and a desperate one. Within a few months, we shall be forced to fight a full-scale battle with the enemy. We will enter that battle with superior fire power, but, unfortunately, with inferior maneuverability. Each of you has met the enemy both during raids and in deep space. You will probably believe me, then, when I tell you that because of that maneuverability we will certainly lose

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that battle. If so, mankind will be through. It will be hunted and harried through the planets until all its dreams are dust." His eyes were burning, his mouth twisted with intensity as he stared down the table.

"Our problem is simple," he continued. "We must not lose that battle. And to win, we must speed up our actions and reactions. According to my staff's calculations, we must somewhere pick up eight seconds. Now where are those eight seconds coming from? That is what you are here for."

He seemed to wait for an answer, but no one spoke up. After looking at each of them in turn, he went on once more, his voice now calm. "Let us consider the links in our chain of communication. The ships of the fleet, and particularly the scouts, pick up the information. It is part of the command strategy to have those scouts in the best possible position. There is nothing we can do there. The data is transmitted back to Earth through hyperspace. Since this is instantaneous, we cannot speed that up. The data is fed to the computers. It is integrated and presented as command problems. We have not time to rebuild the computers — even if we knew how. We have no choice but to accept their time delay. Our strategists are trained to make decisions within a second or two of the problem's presentation. We cannot shorten that. And their decisions go back through the same channels, and the response is effectively instantaneous. Where, gentlemen, in that chain of communication can we shorten the time of action by at least the all-important eight seconds?" His voice had risen almost to a snarl.

"Where can we find the eight seconds that make the difference between the life and death of mankind?"

Tom MacAllistair rumpled his son's hair as he got up from the breakfast table. And walking around the table, he stooped to give his wife, Mary, a quick kiss. Then, grabbing his hat he headed towards the door.

"Tom," Mary called. He looked around. He saw a faint suggestion of a frown on her face, and her eyes seemed to have a certain question in them. He looked at her, hoping his face did not betray him, either directly or by its very impassiveness. She, however, gave a little shrug and a half smile, and only said: "Be home early if you can make it. Cards at the Carlson's tonight, you know."

Even as he said he'd try and walked out, he felt sure that had not been the question in her mind. And if her question had been what he feared, he was thankful she had not asked it. For he wanted this morning to seem like any other. He wanted, for a few minutes at least, to pretend that it was normal.

As he walked slowly to the mammoth building that overshadowed all the little houses that clustered around it, he thought of his family. And he thought of the families of other officers

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who lived in the little white houses. Some of them were probably almost as nice — the wife almost as pretty; the children almost as smart. Some of them were probably not so nice, with a nagging wife or brattish children. But all of them had the right to life. And he tried to hold away the thought that today their fate was in his hands.

On the far hills, the sunlight glittered off the maze of towers. Out there was the mechanism that would soon throw out his orders to the waiting fleet. What if those orders were wrong? What if they were not exactly right? Or not given at just the instant that they should be? There was a nightmare picture in his mind. The little white houses were black, and the lawns and shrubs were seared, the very soil burned black. The hills were scarred with the twisting flames of battle. And all that moved was the great ships of the Enemy as they drifted overhead, looking for the last signs of life on Earth. This would be the price of failure, and he shuddered at the thought.

Entering the central building, he took the salutes of the guards. His mouth twitched in a slight smile, because the salutes were so much snappier than normal. They knew, he thought. They knew the mighty fleets were moving towards their battle, slowly, but at many times the speed of light. They knew, in spite of all secrecy. And they knew, too, although they should not have known, that he was the master strategist who would direct the battle. They knew, and they gave him their best salutes.

Throwing his coat onto a handy chair — let someone else worry about it, today! — he walked into the anteroom of the Control Center. Quickly, he looked around. All the members of the team were there, waiting for him: Harvey, Stevenson, McCall, and all the rest. He nodded to them and took their respectful nods in return. The thought crossed his mind that he should have saluted them. Half of the team outranked him. And Harvey was actually a brigadier general. Why hadn't he, he wondered. Normally he would have. It would have been purely automatic and he would not have thought at all about it. But then, today was different.

Today, General Harvey was only a member of the team, and a lesser one at that. Yesterday, and the months and years before, Harvey had been responsible for the team. The man to build the team, to pick its people and to train them. And to decide just how the Center should be organized. He was a leader of men, and a good one. But he was not a strategist. His mind was not the kind to make the lightning decisions, the instantaneous assessments. That took a special mind. The mathematical wizard type of mind that could absorb at a glance and decide without thought — and also without error. No, today Harvey's sole job was to watch and to decide when the second team should take over. And the

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top men, today, were the strategists. And Tom was the master strategist of the team. And he was briefly amused at himself that because of this fact he had, quite without thought, reversed his normal habits and had not saluted.

Sinking into a chair before a button-studded table, he pushed a lever to start the mechanism of the table. Bending over binocular eyepieces, he saw a picture of space filled with points of light that were the two fleets. With a twist of a dial, he took it back to the situation that he had left the day before, and let it come on up with an accelerated time scale to the present. He watched the symbols dance across that told the orders that had been given. And he watched the points of light move to those orders. And when finally he knew what the situation was, he glanced at the clock, and was startled to see that he had been there an hour. The battle was imminent, and it was time to take control.

Looking up, he saw that the team was ready, waiting for him. With a nod, he got up and led the way to the door.

. . . .

In the Central Control room, he stood for a minute looking over the shoulder of the man he was replacing. At the moment, things were quiet with the two fleets sweeping together. He touched the other man's shoulder and slipped into the seat as the other slid out. From under the table in front of him, he took out a pair of headphones and put them on. Dimly he was aware that only then did the other man take off his phones. He placed his hands on the control panels set into the table and looked at the array of buttons and levers as if to refresh his memory.

Looking up, he glanced first at the screen that hung in front of him. It was blank. His eyes then flashed down to the tank that lay under the screen and just beyond the table. In it, two patterns of lights drifted slowly, one red, one green. These were the fleets, he knew. Green for friend, and red for the enemy. Each point meant a ship. The brighter ones huge battleships, each with the fire power to destroy a planet. The little ones that could hardly be seen, were the scouts. The others with brightness in between were the intermediate ships, with graded fire power and specialized purposes.

He flicked a switch and the individual dots spread out, some into stars of three or six points, some into single or double circles, some into other patterns. Each pattern meant a type of ship and with a glance he memorized them. He flicked the switch back off so that he could see more accurately each ship's position. If he lost track, he could always switch it back on. But it was unlikely he would need to, until the battle was ended. And it was unlikely he would have the time.

He pressed a button. The screen overhead flashed into action, with symbols flashing across it at speeds barely within the limits of even his

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trained perceptions. It lasted for perhaps three seconds, and then the screen was blank. The button had asked the probable correctness of the identification by types of the ships of the enemy. In the flashing symbols he had read the answer, and knew now the probability that each enemy ship was as it was shown. He would remember.

He pressed another button. New symbols flashed. What was the most probable first problem of command? And why? The symbols told him. The first contact would involve a problem. To bore in, or to retreat?

He turned a dial. That section of the fleet came rushing up towards him, expanding in its detail. One small group loomed up — a destroyer group racing toward the enemy. Moving with a random pattern toward a point where the enemy fleet would be, but trying, by deceptive motion, to not show where that point of contact was intended. The pattern of deception was being watched by some other strategist. That other member of the team would also be watching the enemy around the point of intended contact; keeping track of the computer's estimate of the enemy's probable disposition at the time of contact. And deciding when a new command decision would be required.

Quickly he shifted over to the point of contact, and dropped back the amplification. Turning another dial, he noted the probable disposition of the enemy at the time of contact. Dropping the amplification still further until he could see the whole fleet, he quickly scanned and remembered it. And moving forward in time he saw what was the probable future until it faded out in a haze of uncertainty.

Sitting back, he let his conscious mind go blank. His eyes glazed over and his hands dropped limp. An emergency would call the screen to life and he would jump to full alertness, he knew. But this was a trick he knew — to let his mind go blank; to not think or worry or wonder. And when he thought about it consciously, he had a picture of all the little bits of data swarming through his subconscious. And then, as he let the currents die down that were stirred up by conscious thoughts, he visualized these bits pulling together by their own attraction, condensing first into groups and finally into one large pattern. It was a trick of preparation that he knew was valuable.

He stayed there, relaxed, until it was exactly fifteen seconds before his first command decision would be needed. And when it came he was ready.

A battle is a monstrous thing. A vortex of blazing ships and dying men. A storm across which the small ships dash, whipped by the furies of their engines. A complex of forces and of purpose that is unimaginable — a thing of fury, and of death.

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But in Control Center, the battle was none of these. It was a pattern of lights in a tank playing a game of motion and of balance; of symbols flashing across the screen almost, but not quite, too fast to read. Symbols that were themselves counters in the game, items of value, bits of information. A game where each second ticked by without measure filled only with its decisions of move and countermove — of balance and of force. There was no death in the tank. Only the lights that winked off and were gone.

Time held no meaning for Tom and the other strategists. They sat, each hunched over their tank, hands on the controls, eyes flickering between the tank and the screen, completely immersed in the problem of the moment. They were machines, the vital computer element that no man knew how to build. And like a computer, they had no consciousness even of themselves. There was data to be processed, analysis to be called for, and decisions to be made using the uncomputable factor of intuition. For them there was only the moment. Beyond the problem of now, there was no past nor any future.

Only General Harvey watched and knew the past and wondered about the future. He watched the men and noted the speed with which Tom set the general strategy and broke it down into the strategies for smaller areas that could be parceled out to the other strategists. And he watched the other strategists and judged the speed and competence with which they handled the lesser groups of ships. He waited for the break, the slight faltering, the short moment of indecision, that would mean that it was time to alert the second team. And only General Harvey kept completely aware that the future of mankind hung at issue.

The break, when it came, was subtle. The pattern of the dancing lights was still bewildering. The untrained man would not have seen it. Even General Harvey was not sure. Only the team was sure. Only they knew as a fact that the battle had been lost!

Like a wave it swept through them. The first one to know was Tom. From deep in the subconscious where he operated, there came the certain knowledge that there was no hope. From him, and from the knowledge that the other men had, the thought passed to them and they knew it for a fact. And the fact was there. The enemy had won!

It paralyzed them. It was a stark and ugly thing and it broke the trance of intuition. As a man, they looked up, away from their tanks, and stared for an instant with frightened eyes at each other. For the holding of a breath there was no thought of control.

In the instant, General Harvey acted. His hand swept down, punching the red button that would bring the second team on the run. A half hour

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before, he had put them into semialert. There had been no sign of any break, but the battle had even then gone over the hour mark. And even the top team could not go on forever. Twenty minutes was the norm, and he had known that eventually the team would break. And when it came he was prepared.

They moved in, silently, smoothly. They took over, calmly, surely — an instant of final evaluation; a brief review of the moments since they had left the standby room. And they, too, stared at each other. They, too, had realized the truth. They knew that there was no hope beyond a miracle. The enemy had won.

The pause lasted but a moment. And then, smoothly, as if the fact was not a fact, they took over control and the orders cracked out across the silence. For there were still men in the ships.

The ships still had to be disengaged. If mankind had lost and could never again throw its pride across the void, if it would have to live in corners and in fright seeking only to let the enemy forget them so that they might live, then at least there were the years before the enemy could finish off the job. The years in which to pray for a miracle; the years in which to live before they died.

They fought, that second team. They threw their skill and all their knowledge into that fight. There was no hope, but they did not let that knowledge stop them. They fought to save what things they could. And they fought with competence and skill.

Tom and the first team sat in the standby room. They smoked, and some of them drank a little. Not alcohol, because they were still on technical standby, but fruit juices, fortified with vitamins and other things. But they did not talk. Nor did they watch the monitors, or the screen on the wall. They just sat, each man lost in himself — not thinking, hardly even aware. Drained out. Tired. And filled with bleak despair, trying only to keep from thinking of the little white houses that they could not save.

They did not watch, but they knew, somehow, when the final end came. When the white points of light in the tank were scattered and could only run for life itself. And they knew when Control Center could do no more, and authority was transferred to the Tactical Center. And they looked up with vacant eyes as the second team came out, followed with dragging feet, by General Harvey. They knew that it was over, and that the final stamp had been put onto the future of mankind.

When the General came in, the five stars sparkling on his shoulders, only Harvey saluted. The others looked up but did not move.

"Attention!" the General barked. He was silent until they had hauled themselves onto their feet to attention. "Please do not forget that you are on

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duty. That you are not at the moment on active duty does not relieve you of military responsibility." His voice was biting. They stared at him.

General Harvey stepped forward, his eyes cold. "Excuse me, sir," he said, "it is possible you do not understand the situation. The two teams here have just finished directing the battle. They did their best, but it wasn't good enough. It is not an easy thing to know that mankind was depending on us to save it from the enemy, and that even our best was not enough. If we have let this knowledge interfere with military courtesy, it is perhaps regrettable, but I think understandable."

The General looked at him with a sardonic gleam. "As you were, men. Actually, Harvey, I am perfectly aware of the situation and sympathize thoroughly. But I had to get your people to listen somehow, because, you see, it isn't true. We did not lose that battle. We won it." He paused and seemed to chuckle within him.

"It was a question of timing," he said after a moment. "We had the guns to beat them. But not the speed. They can move a little faster than we can. Take a little more acceleration. We were faced with the problem that, by the time we knew what they were going to do, we did not have quite time enough to counter it. And if we had fought this battle in the normal way, we would have lost it. We had to find a way to gain eight seconds. For that was the margin that lay between us." He was talking to General Harvey, but his voice carried over the room.

"I . . . I don't understand, sir," Harvey said.

"We analyzed the problem several months ago," the General went on, ignoring the interruption. "We needed to develop our strategy and counter-strategy eight seconds faster than we had ever done before. We could not gather the data any faster. We could not speed up communication and decision. And we could not put those decisions into action any more quickly. For a while we were stumped. But then it finally occurred to us that there was another step in this chain. If we could know what the enemy was going to do before it could be deduced from their actions, we would gain this eight seconds and more. And when this thought occurred to us, we knew how we could do it." He stopped and looked around, his face intent.

"Gentlemen," he said, his voice measured, "I am sorry to inform you that you fought on the wrong side of the battle."

There was silence in the room. Tom leaned forward, bewildered. He could not see what the General meant.

The General smiled after a moment and went on: "I mean that, gentlemen, quite literally. All the data that we had or could infer about the enemy was presented to you as if it were our fleet. The data about our own fleet,

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filtered to what we thought the enemy could know, was given to you as if it were the enemy. A month or so ago, at your last psychological check-up, you were treated hypnotically to prevent your deducing this fact. And the orders that you gave to what you thought was our fleet did not go to the ships but instead to the Auxiliary Control Center, where it was treated as a high probability prediction of what the enemy would do. And from the Auxiliary Control Center the number three and four teams actually controlled the fleet.

"You can be proud of the fact, gentlemen, that your predictions were sufficiently accurate so that we more than made up the eight-second differential." He hesitated, and then chuckled. "You fought the wrong battle, gentlemen, but you fought it so well that we won the right one." He turned and marched out, leaving them stupefied.

The men of the two teams did not move for perhaps a minute. Then, almost as a body, they walked into an adjoining clubroom, and grouped around the windows looking out at the green lawns and little white houses. And they did not speak at all.

THE END

THE ANALYTICAL LABORATORY

"They'd Rather Be Right" seems to be doing very well for Clifton & Riley; the personal word-of-mouth reports I've gotten seem to be even stronger in its favor than the letter-votes—though I can't annotate them in the Lab here. I'll be interested to watch the results on the last two parts—when the backlash of "Bossy's" inability to help those who think they don't need help shows up!

The September issue, reported here, represented some really tough competition, apparently. "Martians, Go Home!" took second—and from the general tone, I gather it would have made first in most issues!

The score, anyhow, reads like this:

Place	*Story*	*Author*	*Points*
1.	They'd Rather Be Right (Pt. II)	Mark Clifton & Frank Riley	1.93
2.	Martians, Go Home!	Fredric Brown	2.53
3.	The Interlopers	Roger Dee	2.8
4.	Mister Pinschur	Maurice Ogden & Betty Fuller	3.73
5.	The Easy Way	Oscar A. Boch	4.00

THE EDITOR

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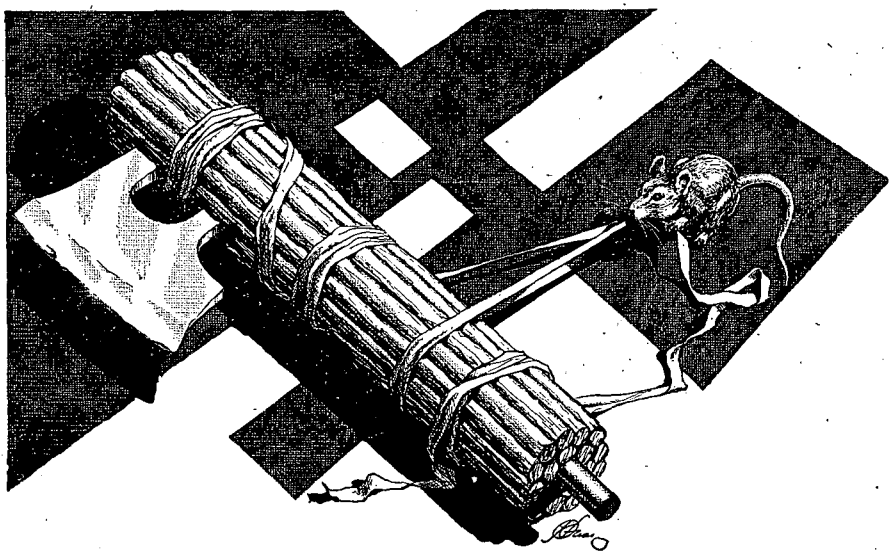

PACK RAT PLANET

BY FRANK HERBERT

The Truth can be very painful — and sometimes the dirtiest trick you can play on a man is to do what he demands!

Illustrated by Freas

Vincent Coogan pulled at his thin lower lip as he stared at the image of his home planet growing larger in the star ship's viewscreen.

"What kind of an emergency would make Patterson call me off a Library collection trip?" he muttered.

The chief navigator turned toward Coogan, noted the down-drooping angles on the Library official's face. "Did you say something, sir?"

"Huh?" Coogan realized he had been speaking his thoughts aloud. He drew in a deep breath, squared his stringy frame in front of the viewscreen, said, "It's good to get back to the Library."

"Always good to be home," said the navigator. He turned toward the planet in the screen.

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It was a garden world of rolling plains turning beneath an old sun. Pleasure craft glided across shallow seas. Villages of flat, chalk-white houses clustered around elevator towers which plumbed the interior. Slow streams meandered across the plains. Giant butterflies fluttered among trees and flowers. People walked while reading books or reclined with scan-all viewers hung in front of their eyes.

The star ship throbbed as its landing auxiliaries were activated. Coogan felt the power through his feet. Suddenly, he sensed the homecoming feeling in his chest, an anticipating that brought senses to new alertness. It was enough to erase the worry over his call-back, to banish his displeasure at the year of work he had abandoned uncompleted.

It was enough to take the bitterness out of his thoughts when he recalled the words someone on an outworld had etched beside the star ship's main port. The words had been cut deeply beneath the winged boot emblem of the Galactic Library, probably with a Gernser flame chisel.

"Go home dirty pack rats!"

The *dirty pack rats* were home.

Director Caldwell Patterson of the Galactic Library sat at the desk in his office deep in the planet, a sheet of metallic paper in his hands. He was an old man even by Eighty-first Century standards when geriatrics made six hundred years a commonplace. Some said he had been *at* the Library that long. Gray hair clung in molting wisps to a pale pate. His face had the leathery, hook-nosed appearance of an ancient bird.

As Coogan entered the office, a desk visor in front of Patterson chimed. The director clicked a switch, motioned Coogan to a chair and said, "Yes," with a tired, resigned air.

Coogan folded his tall frame into the chair and listened with half his mind to the conversation on the visor. It seemed some outworld ship was approaching and wanted special landing facilities. Coogan looked around the familiar office. Behind the director was a wall of panels, dials, switches, rheostats, speakers, microphones, oscillographs, code keys, screens. The two side walls were focus rhomboids for realized images. The wall which was split by the door held eight miniature viewscreens all tuned to separate channels of the Library information broadcasts. All sound switches had been turned to mute, leaving a continuous low murmur in the room.

Patterson began drumming his fingers on the desk top, glaring at the desk visor. Presently, he said, "Well, tell them we have no facilities for an honor reception. This planet is devoted to knowledge and research. Tell them to come in at the regular field. I'll obey my Code and any government order of which I'm capable, but we simply don't have the facilities for what they're asking." The director cut the switch on his visor, turned to Coo-

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gan. "Well, Vincent, I see you avoided the Hesperides green rot. Now I presume you're anxious to learn why I called you back from there?"

Same old didactic, pompous humbug, thought Coogan. He said, "I'm not exactly a robot," and shaped his mouth in a brief, wry smile.

A frown formed on Patterson's bluish lips. "We've a new government," he said.

"Is that why you called me in?" asked Coogan. He felt an upsurge of all the resentment he'd swallowed when he'd received the call-back message.

"In a way, yes," said Patterson. "The new government is going to censor all Library broadcasts. The censor is on that ship just landing."

"They can't do that!" blurted Coogan. "The Charter expressly forbids chosen broadcasts or any interference with Library function! I can quote you —"

Patterson interrupted him in a low voice. "What is the first rule of the Library Code?"

Coogan faltered, stared at the director. He said, "Well —" paused while the memory came back to him. "The first rule of the Galactic Library Code is to obey all direct orders of the government in power. For the preservation of the Library, this must be the primary command."

"What does it mean?" demanded Patterson.

"It's just words that —"

"More than words!" said Patterson. A faint color crept into his old cheeks. "That rule has kept this Library alive for eight thousand years."

"But the government can't —"

"When you're as old as I am," said Patterson, "you'll realize that governments don't know what they can't do until after they cease to be governments. Each government carries the seeds of its own destruction."

"So we let them censor us," said Coogan.

"Perhaps," said Patterson, "if we're lucky. The new Grand Regent is the leader of the Gentle Ignorance Party. He says he'll censor us. The trouble is, our information indicates he's bent on destroying the Library as some kind of an example."

It took a moment for Coogan to accept the meaning of the words. "Destroy —"

"Put it to the torch," said Patterson. "His censor is his chief general and hatchetman."

"Doesn't he realize this is more than a Library?" asked Coogan.

"I don't know what he realizes," said Patterson. "But we're faced with a primary emergency and, to complicate matters, the entire staff is in a turmoil. They're hiding arms and calling in collection ships against my express orders. That Toris Sil-Chan has been around telling every —"

"Toris!"

"Yes, Toris. Your boon companion or whatever he is. He's leading this in-

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surrection and I gather that he —"

"Doesn't he realize the Library can't fight a war without risking destruction?" asked Coogan.

Patterson sighed. "You're one of the few among the new generation who realizes that," he said.

"Where's Toris?" demanded Coogan. "I'll —"

"There isn't time right now," said Patterson. "The Grand Regent's hatchetman is due any minute."

"There wasn't a word of this out on Hesperides," said Coogan. "What's this Grand Regent's name?"

"Leader Adams," said Patterson.

"Never heard of him," said Coogan. "Who's the hatchetman?"

"His name's Pchak."

"Pchak what?"

"Just Pchak."

He was a coarse man with overdrawn features, none of the refinements of the inner worlds. A brown toga almost the same color as his skin was belted around him. Two slitted eyes stared out of a round, pushed-in face. He came into Patterson's office followed by two men in gray togas, each wearing a blaster at the belt.

"I am Pchak," he said.

Not a pretty specimen, thought Coogan. There was something chilling about the stylized simplicity of the man's dress. It reminded Coogan of a battle cruiser stripped down for action.

Director Patterson came around his desk, shoulders bent, walking slowly as befitted his age. "We are honored," he said.

"Are you?" asked Pchak. "Who is in command here?"

Patterson bowed. "I am Director Caldwell Patterson."

Pchak looked him up and down.

"We are at your service," said Patterson.

Pchak's lips twisted into something faintly like a smile. "I would like to know who is responsible for those insulting replies to our communications officer. '*This planet is devoted to knowledge and research!*' Who said that?"

"Why —" Patterson broke off, wet his lips with his tongue, "I said that."

The man in the brown toga stared at Patterson, said, "Who is this other person?" He hooked a thumb toward Coogan.

"This is Vincent Coogan," said Patterson. "He has just returned from the Hesperides Group to be on hand to greet you. Mr. Coogan is my chief assistant and successor."

Pchak looked at Coogan. "Out scavenging with the rest of the pack rats," he said. He turned back to Patterson. "But perhaps there will be need of a successor."

One of the guards moved up to stand beside the general. Pchak said, "Since knowledge is unhappiness, even the word is distasteful when used in a laudatory manner."

Coogan suddenly sensed something electric and deadly in the room. It was evident that Patterson did, too, be-

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cause he looked directly at Coogan and said, "We are here to obey."

"You demonstrate an unhappy willingness to admire knowledge," said Pchak.

The guard's blaster suddenly came up and chopped down against the director's head. Patterson slumped to the floor, blood welling from a gash on his scalp.

Coogan started to take a step forward, was stopped by the other guard's blaster prodding his middle. A red haze formed in front of Coogan's eyes, a feeling of vertigo swept over him. In spite of the dizziness, part of his mind went on clicking, producing information to be observed. *This is standard procedure for oppressors,* said his mind. *Cow your victims by an immediate show of violence.* Something cold, hard and calculating took over Coogan's consciousness.

"*Director* Coogan," said Pchak, "do you have any objections to what has just occurred?"

Coogan stared down at the squat brown figure. *I have to stay in control of the situation,* he thought. *I'm the only one left who'll fight this according to the Code.* He said, "Every man seeks advancement."

Pchak smiled. "A realist. Now explain your Library." He strode around the desk, sat down. "It hardly seems just for our government to maintain a pesthole such as this, but my orders are to investigate before passing judgment."

Your orders are to make a show of investigation before pulling the Library to the torch, thought Coogan. He picked up an image control box from the desk, clipped it to his belt. Immediately, a blaster in a guard's hand prodded his side.

"What is that?" demanded Pchak.

Coogan swallowed. "These are image controls," he said. He looked down at Patterson sprawled on the floor. "May I summon a hospital robot for Mr. Patterson?"

"No," said Pchak. "What are image controls?"

Coogan took two deep breaths; looked at the side wall. "The walls of this room are focus rhomboids for realized images," he said. "They were turned off to avoid distractions during your arrival."

Pchak settled back in the chair. "You may proceed."

The guard continued to hold his blaster on Coogan.

Moving to a position opposite the wall, Coogan worked the belt controls. The wall became a window looking down an avenue of filing cases. Robots could be seen working in the middle distance.

"Terra is mostly a shell," said Coogan. "The major portion of the matter was taken to construct spaceships during the great outpouring."

"That fable again," said Pchak.

Coogan stopped. Involuntarily, his eyes went to the still figure of Cald-

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well Patterson on the floor.

"Continue," said Pchak.

The cold, hard, calculating something in Coogan's mind said, *You know what to do. Set him up for your Sunday punch.*

Coogan concentrating on the screen, said: "The mass loss was compensated by a giant gravitronic unit in the planet center. Almost the entire subsurface of Terra is occupied by the Library. Levels are divided into overlapping squares one hundred kilometers to the side. The wealth of records stored here staggers the imagination. It's —"

"Your imagination perhaps," said Pchak. "Not mine."

Coogan fought down a shiver which crawled along his spine, forced himself to continue. He said, "It is the repository for all the reported doings of every government in the history of the galaxy. The foremat was set by the original institution from which this one grew. It was known as the Library of Congress. That institution had a reputation of —"

"Congress," said Pchak in his deadly flat tones. "Kindly explain that term."

Now what have I said? Coogan wondered. He faced Pchak, said, "Congress was an ancient form of government. The closest modern example is the Tschi Council which —"

"I thought so!" barked Pchak. "That debating society! Would you explain to me, Mr. Coogan, why a recent Library broadcast extolled the virtues of this form of government?"

There's the viper, thought Coogan. He said, "Well, nobody watches Library broadcasts anyway. What with some five thousand channels pouring out —"

"Answer my question, Mr. Coogan." Pchak leaned forward. An eager look came into the eyes of the guard with the blaster. Again Coogan's eyes sought out the still form of Patterson on the floor.

"We have no control of program selection," said Coogan, "except on ten special channels for answering research questions and ten other channels which scan through the new material as it is introduced into the Library."

"No control," said Pchak. "That's an interesting answer. Why is this?"

Coogan rubbed the back of his neck with his left hand, said, "The charter for the broadcasts was granted by the first systemwide government in the Twenty-first Century. A method of random program selection was devised to insure impartiality. It was considered that the information in the Library should always be freely available to all —" His voice trailed off and he wondered if he had quoted too much of the charter. *Well, they can read it in the original if they want,* he thought.

"Fascinating," said Pchak. He looked at the nearest guard. "Isn't that so?"

The guard grinned.

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Coogan took a slow, controlled breath, exhaled. He could feel a crisis approaching. It was like a weight on his chest.

"This has to be a thorough investigation," said Pchak. "Let's see what you're broadcasting right now."

Coogan worked the belt controls and an image realized before the right-hand rhomboid. It was of a man with a hooked nose. He wore leather pants and shirt, shoes with some kind of animal face projecting from the toes, a feather crest hat on his head.

"This is a regular random information broadcast," said Coogan. He looked at his belt. "Channel Eighty-two." He turned up the volume.

The man was talking a language of harsh consonants punctuated by sibilant hisses. Beside him on the floor was a mound of tiny round objects, each bearing a tag.

"He is speaking the dead Procyon language," said Coogan. "He's a zoologist of a system which was destroyed by corona gas thirty-four centuries ago. The things on the floor are the skulls of a native rodent. He's saying that he spent eleven years classifying more than eight thousand of those skulls."

"Why?" asked Pchak. He seemed actually interested, leaned forward to look at the mound of skulls on the floor.

"I think we've missed that part," said Coogan. "It probably was to prove some zoological theory."

Pchak settled back in his chair. "He's dead," he said. "His system no longer exists. His language is no longer spoken. Is there much of this sort of thing being broadcast?"

"I'm afraid ninety-nine per cent of the Library broadcasts — excluding research channels — is of this nature," said Coogan. "It's the nature of the random selection."

"Who cares what the zoologist's theory was?" asked Pchak.

"Perhaps some zoologist," said Coogan. "You never can tell when a piece of information will be valuable."

Pchak muttered something under his breath which sounded like, "Pack rats!"

Coogan said, "Pack rats?"

The little brown man smiled. "That's what we call you," he said. "And with some justification evidently. You're packed with the kind of useless material a rodent would admire."

Time for one small lesson, thought Coogan. He said, "The pack rat, also known as the trade rat, was a rodent indigenous to this planet. It's now extinct here, but there are examples on Markeb IX and several of the Ring planets. The pack rat lived in forest land and was known for his habit of stealing small things from hunters' camps. For everything it took, the pack rat left an item from its nest, a bit of twine, a twig, a shiny piece of glass, a rock. In all of that useless

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material which cluttered its nest there might be one nugget of a precious metal. Since the pack rat showed no selection in its trading — was random, so to speak — it might leave the precious metal in a hunter's camp in exchange for a bottle top."

Pchak got to his feet, walked across the room to the zoologist's image, passed a hand through the projection. "Remarkable," he said, sarcasm filling his voice. "This is supposed to be a nugget?"

"More likely a twig," said Coogan.

Pchak turned back, faced Coogan. "What else do you hide in this rat's nest? Any nuggets?"

Coogan looked down at Patterson on the floor. There was a stillness about the thin old figure. "First, may I have a hospital robot attend to Mr. Patterson?"

The general kept his eyes on Coogan. "No. Answer my request."

First rule of the Code — obey, thought Coogan. With a slow, controlled movement, he shifted a lever on the box at his belt. The Procyon zoologist vanished and the wall became a screen showing a page of a book. *Here's the bait,* thought Coogan, *and I hope it poisons you.* He said, "This is an early account of military tactics showing some methods that succeeded and others that failed."

Pchak turned to the screen, put his hands behind him, rocked back and forth on heels and toes. "What language?"

"Ancient English of Terra," said Coogan. "We have a scanner that'll give you an oral translation if you'd like."

The general kept his eyes on the screen. "How do I know this account is accurate?"

"The Library Code does not permit tampering with records," said Coogan. "Our oath is to preserve the present for the future." He glanced at Pchak, back to the screen. "We have other battle records, the tactics of every species encountered by humans. For example, we have the entire war history of the Praemir of Roman II."

Coogan shifted his belt controls and the screen took up a history of warfare

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which had been assembled for a general sixteen centuries dead. Pchak watched as the record went from clubs and rocks to spears and made a side journey into bizarre weapons. Suddenly, Coogan blanked the screen.

Pchak's head snapped up. "Why did you stop that?"

Hooked him, thought Coogan. He said, "I thought you might rather view this at your leisure. If you wish, I'll set up a viewing room and show you how to order the records when there are side issues you'd like to study." Coogan held his breath. *Now we learn if he's really caught,* he thought.

The general continued to study the blank screen. "I have orders to make a thorough investigation," he said. "I believe this comes under the category of investigation. Have your viewing room prepared." He turned, went to the door, followed by his guards.

"It's down on the sixty-ninth level," said Coogan. "Viewing room A." He started toward Pchak. "I'll get you all set up and —"

"You will remain here," said Pchak. "We will use Viewing Room B, instead. Send an assistant to explain things." He glanced back. "You do have an assistant, do you not?"

"I'll send Toris Sil-Chan," said Coogan and then remembered what Patterson had said about Toris leading the hotheads who wanted to do battle. He would have bitten off his tongue to retract the words, but knew he dared not change now or it would arouse Pchak's suspicions. He returned to the desk, had central-routing find Toris and send him to the viewing room. *Please don't do anything rash,* he prayed.

"Is this assistant your successor?" asked Pchak, looking down at Patterson.

"No," said Coogan.

"You must appoint a successor," said Pchak and left with his two guards.

Coogan immediately summoned a hospital robot for Patterson. The scarab shape came in on silent wheels, lifted the still form on its flat pad extensors and departed.

The sunset rain was drifting along its longitudinal mark on Terra, spattering a shallow sea, dewing the grasslands, filling the cups of flowers. One wall screen of the director's office was activated to show this surface scene — a white village in the rain, flutterings of trees. Surface copters whirred across the village, their metal gleaming in the wetness.

Coogan, his thin face wearing a look of weariness, sat at the director's desk, hands clasped in front of him. Occasionally, he glanced at the wall screen. The spire of a government star ship — tall alabaster with a sunburst insignia on its bow — could be seen beyond the village. Coogan sighed.

A chime sounded behind him. He turned to the control panel wall, de-

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pressed a button, spoke into a microphone. "Yes?"

A voice like wire scraped across a tin plate came out of the speaker. "This is the hospital."

"Well?" Coogan's voice showed irritation.

"Director Patterson was dead upon arrival here," said the wire-scraping voice. "The robots already have disposed of his body through the CIB orifice."

"Don't say anything about it yet," said Coogan. He removed his hand from the switch, turned back to the desk. *His* desk now. *Director Coogan.* The thought gave him no satisfaction. He kept remembering a still form sprawled on the floor. *A terrible way to go,* he thought. *A Librarian should end at his researches, just quietly topple over in the stacks.*

The desk visor chimed. Coogan hit the palm switch and Pchak's face appeared on the screen. The general was breathing rapidly, beads of sweat on his forehead.

"May I help you?" asked Coogan.

"How do I get the condemned instruction records for the Zosma language?" demanded Pchak. "Your machine keeps referring me to some nonsense about abstract symbolism."

The door of Coogan's office opened and Sil-Chan entered, saw that a caller was on the screen, stopped just inside the door. Sil-Chan was a blocky figure who achieved fat without looking soft. His round face was dominated by up-swept almond eyes characteristic of the inhabitants of the Mundial Group planets of Ruchbah.

Coogan shook his head at Sil-Chan, his mind searching through memories for an answer to Pchak's question. It came to him, tagged *semantics study.* "Zosma," he said. "Yes, that was a language which dealt only in secondary referents. Each phrase was two times removed from —"

"What in Shandu is a secondary referent?" exploded Pchak.

Calmly, thought Coogan. *I can't afford to precipitate action yet.* He said, "Ask for the section on semantics. Did Mr. Sil-Chan show you how to get the records you need?"

"Yes, yes," said Pchak. "Semantics, eh?" The screen went blank.

Sil-Chan closed the door, came across the office. "I would imagine," he said, "that the general is under the impression his researches will be completed in a week or two."

"So it would seem," said Coogan. He studied Sil-Chan. The man didn't look like a hothead, but perhaps it had taken this threat to the Library to set him off.

Sil-Chan took a chair across from Coogan. "The general is a low alley dog," he said, "but he believes in this Leader Adams. The gleam in his eyes when he talks about Adams would frighten a saint."

"How was it down in the viewing room?" asked Coogan.

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"Pchak is busy studying destruction," said Sil-Chan. "We haven't made up our minds yet whether to exterminate him. Where's Director Patterson?"

A sixth sense warned Coogan not to reveal that the director was dead. He said, "He isn't here."

"That's fairly obvious," said Sil-Chan. "I have an ultimatum to deliver to the director. Where is he?"

"You can deliver your ultimatum to me," said Coogan dryly.

Sil-Chan's eyes showed little glints deep in the pupils as he stared at Coogan. "Vince, we've been friends a long time," he said, "but you've been away in the Hesperides Group and don't know what's been going on here. Don't take sides yet."

"What's been going on?" asked Coogan. He looked up at Sil-Chan out of the corners of his eyes.

The Mundial native hitched himself forward and leaned an elbow on the desk. "There's a new government, Vince, and they're planning to destroy the Library. And that gourd-head Patterson has been giving in to every order they send. Do this! Do that! He does it! He told us flat out he wouldn't defy a government order." Sil-Chan's mouth set in a thin line. "*It's against the Library Code!*"

"Who is *we*?" asked Coogan.

"Huh?" Sil-Chan looked blank.

"The *we* you said hasn't decided whether to exterminate Pchak," said Coogan.

"Oh." Sil-Chan leaned back. "Only about a third of the home staff. Most of the collection crews are joining us fast as they come in."

Coogan tapped a finger against the desk. *Some eight thousand people, more or less*, he thought. He said, "What's your plan?"

"Easy." Sil-Chan shrugged. "I've about fifty men in Section 'C' on the sixty-ninth level waiting for the word to move against Pchak and his bodyguards. Another three hundred are topside ready to jump the government ship."

Coogan tipped his head to one side and stared at Sil-Chan in amazement. "Is that your ultimatum?"

Sil-Chan shook his head. "No. Where's Patterson?"

Something decisive meshed in Coogan's mind. He got to his feet. "Patterson's dead. I'm director. What's your ultimatum?"

There was a moment's silence with Sil-Chan looking up at Coogan. "How'd he die?" asked Sil-Chan.

"He was old," said Coogan. "What's your ultimatum?"

Sil-Chan wet his lips with his tongue. "I'm sorry to hear that, Vince." Again he shrugged. "But this makes our job simpler. You're a man who'll listen to reason." He met Coogan's stare. "This is our plan. We take over this Pchak and his ship, hold him as hostage while we convert every broadcast channel we have to public support. With five thousand channels

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telling the —"

"You bone-brain!" barked Coogan. "That's as stupid a plan as I've ever heard. Adams would ignore your hostage and drop a stellar bomb in our laps!"

"But, Vince —"

"Don't *but*, *Vince*, me," said Coogan. He came around the desk and stood over Sil-Chan. "As long as you're running around disobeying the orders of your superiors you'll refer to me as Mr. Director and —"

Sil-Chan charged to his feet, glared up at Coogan. "I hate to do this, Vince," he said, "but we have organization and purpose. You can't stop us! You're relieved of your directorship until such time as —"

"Shut up!" Coogan strode around behind his desk, put his hand on a short lever low on the control panel. "Do you know what this is, Toris?"

Sil-Chan's face showed uncertainty. He shook his head.

"This is the master control for the gravitronic unit," said Coogan. "If I push it down, it shuts off the unit. Every bit of soil, everything beyond the Library shell will drift off into space!"

A pasty color came over Sil-Chan's features. He put out a hand toward Coogan. "You can't do that," he said. "Your wife and family — all of our families are up there. They wouldn't have a chance!"

"I'm director here," said Coogan. "The position is my earned right!" With his free hand, he moved four switches on the control wall. "That seals off your sixty-ninth level group behind fire panels." He turned back to Sil-Chan. "Now, get in touch with every insurgent under you and have them turn in their arms to robots which I'll release for the job. I know who some of your men are. They'd better be among the ones you contact. If you make one move I don't like, this lever goes down and stays down!"

"You!" said Sil-Chan. He ground his teeth together. "I knew I should've carried a blaster when I came in here. But no! You and Patterson were the civilized types! We could reason with you!"

"Start making those calls," said Coogan. He pushed his desk visor toward the other man.

Sil-Chan jerked the visor to him, obeyed. Coogan gave his orders to robot dispatching headquarters, waited for Sil-Chan to finish. The Mundial native finally pushed the visor back across the desk. "Does that satisfy you?" he demanded.

"No." Coogan steepled his hands in front of him. "I'm arming some of the staff I can trust. Their orders will be to shoot to kill if there's a further act of insurrection." He leaned forward. "In addition, we're going to have guard stations between sectors and a regular search procedure. You're not getting another chance to cause trouble."

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Sil-Chan clenched and unclenched his fists. "And what do you intend to do about this Pchak and his Leader Adams?"

"They're the government," said Coogan. "As such the Code requires that we obey their orders. I will obey their orders. And, any man on the staff who even hints at disobedience, I'll personally turn over to Pchak for disciplinary action."

Sil-Chan arose slowly. "I've known you more than sixty years, *Mr.* Coogan. That just shows how little you can learn about a rat. After you've lost the Library to this madman, you won't have a friend left here. Not me, not the people who trust you now. Not your wife or your family." He sneered. "Why — one of your own sons, Phil, is in with us." He pointed a finger at Coogan. "I intend to tell everyone about the threat you used today to gain control of the Library."

"Control of the Library is my earned right," said Coogan. He smiled, pushed down the lever in the control wall. The wall made a quarter turn on a central pivot. "Toris, send up a repair robot when you report back to Pchak. I've special installations I want to make here."

Sil-Chan came to the edge of the desk, staring down at the lever which had controlled the movement of the wall. "Tricked me!"

"You tricked yourself," said Coogan. "You did it the moment you turned your back on our greatest strength — obedience to the government."

Sil-Chan grunted, whirled and left the office.

Coogan watched the door as it closed behind the other man, thought, *If I only had as much faith in those words as I'm supposed to have.*

She was a pretty woman with hair like glowing coals, small features except for a wide, sensual mouth. Her green eyes seemed to give off sparks to match her hair as she stared out of the visor at Coogan.

"Vince, where have you been?" she demanded.

He spoke in a tired voice. "I'm sorry, Fay. I had work that had to be done."

She said, "The boys brought their families from Antigua for a reunion and we've been ready for you for hours. What's going on? What's this nonsense Toris is bleating?"

Coogan sighed and brushed a hand through his hair. "I don't know what Toris is saying. But the Library is in a crisis. Patterson is dead and I've nobody I can trust to hold things together."

Her eyes went wide; she put a hand to her mouth, spoke through her fingers. "Oh, no! Not Pat!"

"Yes," he said.

"How?"

"I guess it was too much for him," said Coogan. "He was old."

"I couldn't believe Toris," she said.

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Coogan felt a great weariness just at the edge of his mind. "You said the boys are there," he said. "Ask Phil if he was part of the group backing Toris."

"I can tell you myself he was," she said. "It's no secret. Darling, what's come over you? Toris said you threatened to dump the whole surface off into space."

"It was an empty threat then," said Coogan. "Toris was going to disobey the government. I couldn't permit it. That would only —"

"Vince! Have you gone out of your mind?" Her eyes registered amazement and horror. "This Adams means to destroy the Library! We can't just sit back and let him!"

"We've grown lax in our training," said Coogan. "We've had it too easy for too long. That's a situation I intend to correct!"

"But what about —"

"If I'm permitted to handle things my way, he won't destroy the Library," said Coogan. "I was hoping you'd trust me."

"Of course I trust you, darling, but —"

"Then trust me," he said. "And please understand that there's no place I'd rather be right now than home with you."

She nodded. "Of course, dear."

"Oh, yes," he said, "tell Phil he's under house arrest for deliberate disobedience to the Code. I'll deal with him, personally, later." He closed the switch before she could reply.

Now for General Pchak, he thought. *Let's see if he can give us a hint on how to deal with Leader Adams.*

The room was vaguely egg-shaped for acoustical reasons, cut at one end by the flat surface of a screen and with space in the center for a realized image. The wall opposite the screen was occupied by a curved couch split by drop arms in which control instruments were set.

Pchak was sprawled on the couch, a brown blob against the gray plastic, watching two Krigëllian gladiators spill each other's blood in an arena which had a shifting floor. As Coogan entered, Pchak turned the screen to a book page in the Zosma language of Krigëllia, scanned a few lines. He looked up at Coogan with an expression of irritation.

"*Director* Coogan," said Pchak, "have you chosen a successor yet?" He slid his feet to the floor. "I find semantics most interesting, *Director* Coogan. The art of using words as weapons appeals to me. I'm particularly interested in psychological warfare."

Coogan stared thoughtfully at the figure in the brown toga, an idea racing through his mind. *If I get this barbarian started on a study of psychological warfare, he'll never leave.* He pulled out a section of the curved couch, sat down facing Pchak. "What's the most important thing to know about a

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weapon?" he asked.

The general's forehead creased. "How to use it effectively, of course."

Coogan shook his head. "That's an overgeneralization. The most important thing is to know your weapon's limitations."

Pchak's eyes widened. "What it *cannot* do. Very clever."

"Psychological warfare is an extensive subject," said Coogan. "According to some, it's a two-edged sword with no handle. If you grasp it strongly enough to strike down your enemy, you render yourself *hors de combat* before your blow is delivered."

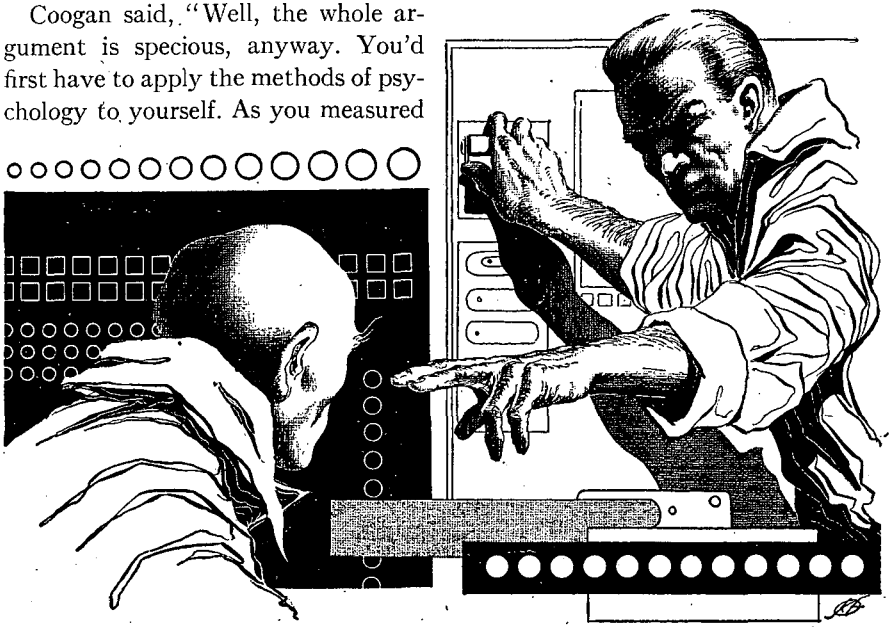
Pchak leaned against an arm of the couch. "I don't believe I understand you."

Coogan said, "Well, the whole argument is specious, anyway. You'd first have to apply the methods of psychology to yourself. As you measured more and more of your own sanity, you'd be more and more incapable of using the weapon against another."

In a cold voice, Pchak said, "Are you suggesting that I'm insane?"

"Of course not," said Coogan. "I'm giving you a summary of one of the arguments about psychological warfare. Some people believe any warfare is insanity. But sanity is a matter of degree. Degree implies measurement. To measure, we must use some absolute referent. Unless we could agree on the measuring device, we couldn't say anyone was sane or insane. Nor could we tell what opponent might be vulnerable to our weapon."

Pchak jerked forward, a hard light



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in his slitted eyes.

Coogan hesitated, wondered, *Have I gone too far?* He said, "I'll give you another example." He hooked a thumb toward the viewscreen. "You just watched two gladiators settle an issue for their cities. That particular action occurred twenty centuries ago. You weren't interested in the issue they settled. You were examining their method of combat. Twenty centuries from now, who will examine your methods? Will they be interested in the issues you settled?"

Pchak turned his head to one side, keeping his eyes on Coogan. "I think you're using clever words in a way to confuse me," he said.

"No, general." Coogan shook his head. "We're not here to confuse people. We believe in our Code and live by it. That Code says we must obey the government. And that doesn't mean we obey when we feel like it or when we happen to agree with you. We obey. Your orders will be carried out. It doesn't pay us to lead you into confusion."

In a strangely flat voice, Pchak said, "Knowledge is a blind alley leading only to unhappiness."

Coogan suddenly realized that the man was quoting Leader Adams. He said, "We don't put out knowledge, general. We store information. That's our first job."

"But you blat that information all over the universe!" stormed the general. "Then it becomes knowledge!"

"That is under the Charter, not the Code," said Coogan.

Pchak pursed his lips, leaned toward Coogan. "Do you mean if I ordered you to shut down your broadcasts, you'd just do it? We understood you were prepared to resist us at every turn."

"Then your information was incorrect," said Coogan.

The general leaned back, rubbed his chin. "All right, shut them down," he said. "I'll give you a half hour. I want all five thousand of them quiet and your special channels, too."

Coogan bowed, got to his feet. "We obey," he said.

In the director's office Coogan sat at the desk, staring at the opposite wall. The screens were silent. It was almost as though there was some interspatial hole in the room, a lack. The door opened and Sil-Chan entered. "You sent for me?" he asked.

Coogan looked at the man for a moment before speaking, then said, "Why didn't you return to Pchak's viewing room as I ordered?"

"Because Pchak dismissed me," said Sil-Chan curtly.

"Come in and sit down," said Coogan. He turned on his desk visor, called records. "What's the parentage and upbringing of the new Grand Regent?" he asked.

After a brief pause, a voice came from the visor: "Leader Adams, also known as Adam Yoo. Mother, Simila

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Yoo, native of Mundial Group"—Coogan glanced at Sil-Chan—"planet Sextus C III. Father Princeps Adams, native of Hercules Group. Father was killed in accident with subspace translator on University Planet of Hercules XII when son age nine. Young Adams raised with mother's family on Sextus C II until age eighteen when sent to Shandu for training as a Mundial religious leader. While on Shandu—"

Coogan interrupted, "Send me a transcript on it." He broke the connection, looked at Sil-Chan. "Still angry, Toris?"

Sil-Chan's lips tightened.

As though he had not noticed, Coogan said, "Adams' father was killed in an accident on a university planet. That could be the unconscious origin of his hatred of knowledge." He looked speculatively at Sil-Chan. "You're a Mundial native. What's the group like?"

"If Adams was raised there, he's a mystic," said Sil-Chan. He shrugged. "All of our people are mystics. No Mundial family would permit otherwise. That's why he was taken to the home planet to be raised." Sil-Chan suddenly put a hand to his chin. "Father killed in an accident—" He looked at Coogan, through him. "That could have been an *arranged* accident." He leaned forward, tapped the desk. "Let's say the father objected to the son being raised in the Mundial Group—"

"Are you suggesting that the mother could have arranged the accident?"

"Either she or some of her kinsmen," said Sil-Chan. "It's been known to happen. The Mundials are jealous of their own. I had the glax of a time getting permission to come to the Library staff."

"This happiness through ignorance cult," said Coogan. "How would mysticism bear on that?"

Sil-Chan looked at the desk surface, forehead creased. "He'll believe absolutely in his own destiny. If he thinks he has to destroy the Library to fulfill that destiny, there'll be no stopping him."

Coogan clasped his hands together on the desk top, gripped them until they hurt. *Obey!* he thought. *What a weapon to use against a fanatic!*

"If we could prove the mother or the Yoo Clan had the father killed, that might be a valuable piece of knowledge," said Sil-Chan.

"A wise man depends upon his friends for information and upon himself for decisions," said Coogan.

"That's a Mundial axiom," said Sil-Chan.

"I read it somewhere," said Coogan. "You're a Mundial native, Toris. Explain this mysticism."

"It's mostly rubbed off of me," said Sil-Chan, "but I'll try. It revolves around an ancient form of ancestor worship. Mysticism, you see, is the art of looking backward while convincing yourself that you're looking

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forward. The ancient Terran god Janus was a mystic. He looked forward and backward at the same time. Everything a mystic does in the present must find its interpretation in the past. Now, the interpretation —"

"That's a subtle one," said Coogan. "It almost slipped past me. *Interpretation*. Substitute *explanation* for *interpretation* —"

"And you have a librarian," said Sil-Chan.

"Explanation is something that may or may not be true," said Coogan. "We're convinced of an interpretation."

"Semantics again," said Sil-Chan. A brief smile touched his lips. "Maybe that's why you're director."

"Still against me?" asked Coogan.

The smile left Sil-Chan's mouth. "It's suicide, Vince." He hitched himself forward. "If we follow your orders, when this Adams says to destroy the Library, we'd have to help him!"

"So we would," said Coogan. "But it's not going to come to that. I wish you'd trust me, Toris."

"If you were doing something that even remotely made sense, of course I would," said Sil-Chan. "But —" He shrugged.

"I've a job for you," said Coogan. "It may or may not make sense, but I want it carried out to the letter. Take any ship you can get and hop to this Sextus C III in the Mundial Group. When you get there, I want you to prove that the Yoo Clan killed Leader Adams' father. I don't care whether it's true or not. I want the proof."

"That makes sense," said Sil-Chan. "If we can discredit the big boss —"

The visor chimed. Coogan hit the switch and a sub-librarian's face appeared in the screen. "Sir," the man blurted, "the Library information broadcasts are silent! I just got a call from —"

"Orders of the government," said Coogan. "It's quite all right. Return to your duties." He blanked the screen.

Sil-Chan was leaning on the desk, fists clenched. "You mean you let them close us down without a struggle."

"Let me remind you of some things," said Coogan. "We must obey the government to survive. I am director here and I've given you an order. Get on it!"

"What if I refuse?"

"I'll get somebody else to do it and you'll be locked up."

"You don't leave me any choice." He turned and slammed out of the office.

Twenty-four times the evening rains passed across the tower far above Coogan's office. The game of cat-and-mouse with Pchak went on as usual, the little brown general delving deeper and deeper into the files. On the twenty-fifth day Coogan came into his office in mid afternoon.

Pchak is completely hooked, he

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thought, *but what happens when Adams finds out the Library hasn't been destroyed?*

He sat down at his desk, swiveled to face the control panel and activated a tiny screen linked to a spy cell on the sixty-ninth level. Pchak was in the viewing room, studying the Albireo language preparatory to examining that double-star system's war history. Behind Coogan, a mechanical hum sounded, indicating someone was emerging from the elevator. Hastily, he blanked the spy screen, turned to his desk just as the door burst open. Toris Sil-Chan staggered into the room, his clothing torn, a dirty bandage over one shoulder.

The Mundial native lurched across the room, clutched the edge of Coogan's desk. "Hide me!" he said. "Quick!"

Coogan jerked around to the panel, swung it open and motioned toward the hole that was exposed. Sil-Chan darted in and Coogan closed the panel, returned to his desk.

Again the telltale signaled. Two armed guards burst into the room, blasters in their hands. "Where is he?" demanded the first.

"Where's who?" asked Coogan. He squared a stack of papers on his desk.

"The guy who jumped off that lifeboat," said the guard.

"I don't know what you're talking about," said Coogan, "but I can see that I'll have to call General Pchak and tell him how you've burst into my office without preamble and —"

The guard lowered his blaster and retreated one step. "That won't be necessary, sir," he said. "We can see the man's not here. He probably went to a lower level. Please excuse the interruption." They backed out of the room.

Coogan waited until his spy relays in the corridor told him the men had gone, then opened the panel. Sil-Chan was crumpled on the floor. Coogan bent over him, shook him. "Toris! What's wrong?"

Sil-Chan stirred, looked up at Coogan with eyes that were at first unrecognizing. "Uh . . . Vince —"

The director put an arm behind Sil-Chan, supported the man to a sitting position. "Take it easy now. Just tell me what happened."

"Made a mess of assignment," said Sil-Chan. "Yoo Clan got wind of what I was after. Had Adams send order . . . arrest. Lost ship. Got away in escape boat. Landed other side . . . planet. Pchak's guards tried stop —" His head slumped forward.

Coogan put a hand to the man's heart, felt its steady pumping. He eased Sil-Chan back to the floor, went out and summoned a hospital robot. Sil-Chan regained consciousness while the robot was lifting him. "Sorry to go out on you like that," he said. "I —"

The message visor on the director's desk chimed. Coogan pushed the response switch, scanned the words of a visual message, blanked the screen and

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turned back to Sil-Chan. "You'll have to be treated here," he said. "Couldn't risk carrying you through the corridors right now."

The spy beam hummed at the door. Coogan pushed Sil-Chan behind the panel, closed it. Pchak strode into the office, a blaster in his hand, the two guards behind him. The general glanced at the hospital robot, looked at Coogan. "Where's the man that robot was called to treat?"

The last guard into the office closed the door, drew his blaster.

"Talk or you'll be cut down where you stand," said Pchak.

The showdown, thought Coogan. He said, "These hospital-robots are a peculiar kind of creature, general. They don't have the full prime directive against harming humans because sometimes they have to choose between saving one person and letting another one die. I can tell this robot that if I'm harmed it must give all of you an overdose of the most virulent poison it carries in its hypo arm. I inform the robot that this action will save my life. It naturally is loyal to the Library and will do exactly what I have just now told it to do."

Pchak's face tightened. He raised the blaster slightly.

"Unless you wish to die in agony, place your blasters on my desk," said Coogan.

"I won't," said Pchak. "Now what're you going to do?"

"Your blasters can kill me," said Coogan, "but they won't stop that robot until it has carried out my order."

Pchak's finger began to tighten on the trigger. "Then let's give it the —"

The sharp *blat!* of an energy bolt filled the room. Pchak slumped. The guard behind him skirted the robot fearfully, put his blaster on Coogan's desk. The weapon smelled faintly of ozone from the blast that had killed Pchak. "Call that thing off me now," said the man, staring at the robot.

Coogan looked at the other guard. "You, too," he said.

The other man came around behind the robot, put his weapon on the desk. Coogan picked up one of the weapons. It felt strange in his hand.

"You're not going to turn that thing loose on us now, are you?" asked the second guard. He seemed unable to take his gaze from the robot.

Coogan glanced down at the scarab shape of the mechanical with its flat pad extensors and back hooks for carrying a stretcher. He wondered what the two men would do if he told them the thing Pchak had undoubtedly known — that the robot could take no overt action against a human, that his words had been a lie.

The first guard said, "Look, we're on your side now. We'll tell you everything. Just before he came down here, Pchak got word that Leader Adams was coming and —"

"Adams!" Coogan barked the

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word. He thought, *Adams coming! How to turn that to advantage?* He looked at the first guard. "You were with Pchak when he came the first day, weren't you?"

"I was his personal guard," said the man.

Coogan scooped the other blaster off his desk, backed away. "All right. When Adams lands, you get on that visor and tell him Pchak wishes to see him down here. With Adams a hostage, I can get the rest to lay down their arms."

"But —" said the guard.

"One false move and I turn that robot loose on you," said Coogan.

The guard's throat worked visibly. He said, "We'll do it. Only I don't see how you can get the whole government to give up just because —"

"Then stop thinking," said Coogan. "Just get Adams down here." He backed against the control wall and waited.

"I don't understand," said Sil-Chan.

The Mundial native sat in a chair across the desk from Coogan. A fresh Library uniform bulged over Sil-Chan's bandaged shoulder. 'You pound it into us that we have to obey," he said. "You tell us we can't go against the Code. Then at the last minute you turn around and throw a blaster on the whole crew and toss them into the hospital's violent ward."

"I don't think they can get out of there," said Coogan.

"Not with all those guards around them," said Sil-Chan. "But it's still disobedience and that's against the Code." He held up a hand, palm toward Coogan. "Not that I'm objecting, you understand. It's what I was advocating all along."

"That's where you're mistaken," said Coogan. "People were perfectly willing to ignore the Library and its silly broadcasts as long as that information was available. Then the broadcasts were stopped by government order."

"But —" Sil-Chan shook his head.

"There's another new government," said Coogan. "Leader Adams was booted out because he told people they couldn't have something. That's bad policy for a politician. They stay in office by telling people they can *have* things."

Sil-Chan said, "Well, where does —"

"Right after you came stumbling in here," said Coogan, "I received a general order from the new government which I was only too happy to obey. It said that Leader Adams was a fugitive and any person encountering him was empowered to arrest him and hold him for trial." Coogan arose, strode around to Sil-Chan, who also got to his feet. "So you see," said Coogan, "I did it all by obeying the government."

The Mundial native glanced across Coogan's desk, suddenly smiled and went around to the control wall. "And

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you got me with a tricky thing like this lever." He put a hand on the lever with which Coogan had forced his submission.

Coogan's foot caught Sil-Chan's hand and kicked it away before the little man could depress the lever.

Sil-Chan backed away, shaking his bruised hand. "Ouch!" He looked up at Coogan. "What in the name of —"

The director worked a lever higher on the wall and the panel made a quarter turn. He darted behind the wall, began ripping wires from a series of lower connections. Presently, he stepped out. There were beads of perspiration on his forehead.

Sil-Chan stared at the lever he had touched. "Oh, no —" he said. "You didn't *really* hook that to the grav unit!"

Coogan nodded mutely.

Eyes widening, Sil-Chan backed against the desk, sat on it. "Then you weren't certain obedience would work, that —"

"No, I wasn't," growled Coogan.

Sil-Chan smiled. "Well, now, there's a piece of information that ought to be worth something." The smile widened to a grin. "What's my silence worth?"

The director slowly straightened his shoulders. He wet his lips with his tongue. "I'll tell you, Toris. Since you were to get this position anyway, I'll tell you what it's worth to me." Coogan smiled, a slow, knowing smile that made Sil-Chan squint his eyes.

"You're my successor," said Coogan.

THE END

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BY P. SCHUYLER MILLER

HUMAN ENGINEERING

Whether or not atomic weapons are outlawed by mutual consent, and the convention observed, there is no question that the age of military rockets has been reborn—and with it a new era of *controlled* rocketry for transportation, research, and the opening of Space.

Of these, the greatest was the first long-range rocket which its German inventors called A-4 and which Hitler renamed "V-2"—Vengeance Weapon 2. It was the direct descendant of the civilian-produced liquid-fuel rockets of the Mirak family which members of the *Verein für Raumschiffährt* built and tested at their *Raketenflugplatz* north of Berlin, and it is the direct ancestor of the present-day rockets with which the United States and other countries are probing the limits of the atmosphere.

V-2 was developed by the German Army Weapons Department under the direction and supervision of Colonel—later General—Walter Dornberger, an engineer whose interest in rockets seems to have gone back to his first assignment to the Ballistics Branch in 1930. He tells his story of that development in "V-2" (Viking Press, New York; 1954; 281 + xvi pp.; ill.; $5.00).

If you expect to find in General Dornberger's book the story of the

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scientific problems which were raised and solved in the construction of the V-2, you will probably be disappointed. The best source for that, among the general books I have seen, is still Willy Ley's "Rockets, Missiles and Space Travel," Chapters 6 and 8. In fact, no very clear picture of the author as a person, a military man, or a scientist emerges from his book. What does appear from almost the beginning is a picture of a man who through sheer administrative genius was able to sustain and drive forward the Army rocket project in spite of day-to-day efforts to scuttle it.

Whatever his military or scientific qualifications may have been, General Dornberger was evidently a highly proficient human engineer. It is this phase of his work that makes "V-2" a fascinating and indispensable supplement to Willy Ley's classic.

As many older readers of this magazine will remember, the V.f.R. was Space-oriented and as internationalist as most movements for pure science. Willy Ley, in particular, built up an imposing "auslands" membership in the early '30s (I was one of them in my college days, and recall using their papers on the basic theory of rockets as source material for a physics seminar). Meanwhile the Army had realized vaguely that rockets were one type of weapon not forbidden under the Treaty of Versailles. In 1932 they moved in, hired the V.f.R.'s small body of unpaid experts (Wernher von Braun and Walter Riedel—who may or may not be the same as Ley's "Klaus" Riedel), and move the center of experimental work to the Army test station at Kummersdorf West, in another Berlin suburb. From here on, it is General Dornberger's story.

His first problem was to get anyone in authority to take rockets seriously. The Army had powder-rockets, and continued to develop them independently into something which met many military needs. The powers-that-were, indoctrinated by the publicity given the space-flight aspirations of von Braun and his co-workers, found it difficult to see the military possibilities of that kind of rocketry. The Nazi party soon took over in Germany, and there were plenty of other military uses for the money and materials the Kummersdorf experimenters needed. So Colonel Dornberger began his long war with bureaucracy, politics and greed. (To give the bureaucrats their due, they found it hard to understand why the Army should requisition two boxes of Christmas-tree sparklers—we used to use them as a dull substitute for firecrackers and rockets on the Fourth of July—in the middle of summer: they were to ignite the alcohol-oxygen mixture in the rocket motor.)

The end of the Peenemunde peninsula, on the Baltic coast due north of Berlin and opposite the tip of Sweden, was set up as an Army Experimental Station in 1936: it seems to have been

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von Braun's find, after the "Strength Through Joy" movement asserted its higher priority to the nearby island of Rügen. Other agencies of higher political importance were to follow the example with discouraging regularity over the years. The first shots were fired from the tiny island Greifswalder Oie, five miles off shore, in December 1937. By this time Dr. Walter Thiel had joined von Braun and Walter Riedel in the scientific nucleus of Peenemunde, coming from the Research Branch of the Army Weapons Department.

As I have said, although "V-2" catalogues the successes and failures of the various Peenemunde experiments in considerable detail, General Dornberger does not, whether intentionally or inadvertently, give a clear picture of how the scientific problems of the A-4 and its predecessors were solved. That must be some other writer's book—perhaps von Braun's. But there were successes, and the atmosphere began to change and the fog of inertia and obstructionism to lift. It soon closed in again. Hitler watched a test at Kummersdorf, was not impressed, and cut Peenemunde off the priority list for scarce materials (there was no salvage value in the remains of a test rocket!).

Then the political war behind the military war began in earnest. Dornberger refused to stop fighting for support. He seems to have oversold his case: the work on rockets appeared important enough so that the Ministry of Munitions placed the project under a special committee headed by "a man called Degenkolb," an expert on locomotives who was reputed to have driven General Becker, the Army Weapons Department head who had first encouraged the rocket projects, to suicide. Degenkolb, it appeared, would convert ivory-tower research into military production overnight. . . .

Degenkolb was impressed by what he saw at Peenemunde—so much so that the next move by the politicians behind the Ministry of Munitions was an attempt to convert the Army project into a private stock company, managed by some large industry. The hundred-million-mark assets would be given a paper value of a round million and the results of the Army's research taken over and sold back to it at a nice profit. Dornberger won that round, but Degenkolb never abandoned his plan until V-2 had become so important to the foundering German military scheme that any such shenanigans were out of the question.

One after another the obstacles were put in the way of the researchers. Hitler dreamed that V-2's would never reach England. The V-1 buzz-bombs were put into production and gave a quick impression of success—only the parallel success of the British in knocking them down almost as fast as they came over gave true rockets a new lease on life. Degenkolb's production committee continued to make de-

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mands that could not possibly be fulfilled. And the R.A.F. raid of August 17, 1943 caught Peenemunde at the height of its success and killed Dr. Thiel and his family.

Finally the SS moved in.

Reading between the lines, and supplementing with Willy Ley's reports, it appears that as the work at Peenemunde became better known and more successful, everyone wanted to get into the rocket act—and to take it over. Such industries as Rheinmetall, which developed the powder step-rocket *Rheinbote*, wanted to expand into the liquid-fuel field. The Air Force and SS had their own research programs, employing others of the V.f.R. and other pre-Hitler experimenters. All of them were jealous of each other, and of the Army which alone among them was showing results. Himmler and his SS, unfortunately had more power than all the rest combined—and it was Himmler whom General Dornberger had to take on as his last big political antagonist. Von Braun and Riedel were arrested and charged with the sabotage of stating publicly that their real, ultimate objective was space travel. Dornberger himself was threatened with "a fat file." Titan met titan.

From General Dornberger's book—admittedly a prejudiced account—it seems very clear that without the perpetual political struggle which hampered his every move, the A-4 rocket might have been Germany's first V-weapon, and that it might have been a vastly more terrible weapon than it was. General Eisenhower, in "Crusade in Europe," has said that if these rockets had been used six months before they were, the invasion of Europe would have been delayed and perhaps made impossible. With the priorities they needed and without the constant attacks from within the government, the Peenemunde scientists might have had a rocket which would come up to their own stiff specifications—notably, a dispersion or scatter of only 20 or 3 mils (2 or 3 feet for every 1000 feet of range), compared with an acceptable dispersion some twenty times greater in artillery fire. The V-2 that General Dornberger and his staff visualized was the long-range, *fully guided* rocket missile that we are only now achieving after our fresh post-war start.

Even though this is a disappointing book from the technical standpoint, it is fascinating as a view of how a modern research team, with someone running political interference, can operate under the greatest difficulties. I hope that some day the story can be retold in full, by some scientist-journalist who can watch the struggle from outside, through the records and letters of the SS and other parties involved. Until then, and probably as long as rockets exist, General Dornberger's book will be essential in any rocketry library.

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THE CONQUERED PLACE, by Robert Shafer. G. P. Putnam's Sons, New York. 1954. 313 pp. $3.50.

This will be listed as science fiction in that it deals with a near future in which Soviet forces have overrun all the eastern half of the United States, the government is in exile in Mexico, and a kind of stalemate has been reached at the Mississippi. A young lieutenant is sent into Occupied Ohio to bring out a scientist, working there for the enemy but willing to escape if his family is rescued, too. The rest of the book deals with his efforts to break through the sullen resistance of the Resistance leaders, all of them individualists, all of them given to bickering and oratory while time wastes. This does produce suspense, but of the kind that is as much impatience as identification with the characters. Maybe Undergrounds are like this; if so, it's a miracle that they accomplish as much as they do.

UNTOUCHED BY HUMAN HANDS, by Robert Sheckley. Ballantine Books, New York. 1954. 170 pp. $2.50 & 35¢.

As he appears in this collection of his short stories, Robert Sheckley stands in relation to the early Ray Bradbury about as Bradbury then stood to John Collier. There is the same fresh point of view, especially the fresh *nonhuman* point of view. There are the same wry distortions of the familiar. There is a touch of the same poetry, and it seems to me more than a touch of the same style.

Of course, it's where Sheckley goes from here that counts, as it has with Bradbury—and it's too soon to see where that will be. I hope it isn't in Bradbury's direction of ingrown stylism, and that a little of the savor which would have been right at home in *Unknown* will remain.

Of the thirteen stories in "Untouched by Human Hands," all but two can be called science fiction. Only one, "The Impacted Man," was published here. In "The Monsters" a human expedition appears monstrous because of its "inhuman" social customs; in "Ritual" another expedition struggles against what the aliens believe to be human customs. "Cost of Living" is very close to a number of Bradbury treatments of our mechanized future.

"The Altar" and "The Demons"—the latter with a humorous twist—are the out-and-out weirdies of the collection, though you may care to include "The King's Wishes" with its refrigerator-pilfering ferra. "Shape" shows us the revolt of an alien people against its stereotypes; "Specialist" counterpoises with a wholly shapeful civilization in which we have an unexpected part. "Untouched By Human Hands" (previously "One Man's Poison") is the closest thing to a routine science-fiction problem in the book, though "Beside Still Waters"—

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to ring in another poet-fantast—is close to some of Lester del Rey's memorable robot stories.

Finally, "Warm" goes devilishly into a doomed mind and "Seventh Victim" has (let's face it!) a Fritz Leiber savagery to the close. I wish I'd had thirteen stories as good as these when I was twenty-four—or forty-four, for that matter.

INTO SPACE, by P. E. Cleator. Allen & Unwin, London. 1953. 159 pp. Ill. 15s

Readers of ASF will certainly remember Mr. Cleator's "Rockets Through Space," which in 1936 was one of the first books to present the rocket story in English. This little volume, which may later be reprinted over here, comes a bit late, after many less qualified writers have told the story over and over.

What is new is Cleator's personal narrative of the early days of the rocket movement. He heads his chapters with devastating quotations from his critics of those times: *Nature*, one of the world's top science magazines, reviewed his earlier book with the comment: "Mr. Cleator thinks it a pity that the Air Ministry evinced not the slightest interest in his ideas; provided that an equal indifference is shown by Ministries elsewhere, we all ought to be profoundly thankful." And we learn that the British Explosives Act of 1875 was invoked by the Secretary of State to prohibit the British Interplanetary Society from conducting liquid-fuel rocket research.

In addition to these fascinating personal notes, the book offers the usual basics of space-rocketry: how a rocket works, what problems must be surmounted to get a rocket into space, what other worlds there are and what they may be like. I wish Mr. Cleator had been earlier in the field: poorer books will have exhausted much of his potential market.

NINE TALES OF SPACE AND TIME, edited by Raymond J. Healy. Henry Holt & Co., New York. 1954. 307 pp. $3.50

Top news of the year! John Campbell's writing again, and he hasn't missed a trick since his Don A. Stuart days.

Your editor's "The Idealists" is the first of nine brand new stories which Ray Healy has commissioned for his second new-story collection, and it's one of the best in the lot. It's a story of the clash between Earthling and non-Earthling values in an alien humanoid culture. I think I'd have been happier without the extra gimmick in the last six pages.

Just as Anthony Boucher's "The Quest for St. Aquin" was one of the most outstanding items in the first Healy collection, so his "Balaam," developing another religious theme with quiet maturity and sweet-sour

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perceptiveness, stands out in this book. So must Kris Neville's sequel to "Bettyann" (the top of "New Tales of Space and Time"), "Overture," in which the alien girl learns what she must do to live among human beings. It's not quite up to the first story, though.

From R. Bretnor we get "Genius of the Species," not a Papa Schimmelhorn story but a wholly good-natured look at a cat's life behind the Iron Curtain. And J. Francis McComas, co-editor with Ray Healy of the original classic among anthologies, *Adventures in Time and Space*, hits an unusual aspect of life on a colony-world with his story of a penologist's problems, "Shock Treatment."

The remaining stories are good but not outstanding. Dr. David H. Fink, author of "Release from Nervous Tension," imagines what would happen if "Compound B," a drug which steps up the taker's mental power manyfold, is made available to do for whites what Dr. Murdock's Compound A does for the colored races. Frank Fenton, in "The Chicken or the Egghead," reverses the procedure with a drug which makes a Hollywood intellectual absolutely mediocre. They're both fun. And Ray Healy himself tries a period-piece, based on an actual mystery of 1855, in "The Great Devon Mystery." Finally, H. L. Gold (you will notice that Healy has inviegled stories out of the editors of *Astounding*, *Galaxy* and *Fantasy and Science-Fiction*) writes "Man of Parts," in which a cracked-up human explorer tries to escape from the over-kindness of his utterly alien rescuers.

I don't think this comes up to the first Healy experiment—nothing in it quite reaches the stature of "Bettyann" or "St. Aquin"—but it's one of the best anthologies you'll be seeing in 1954.

THE BEST FROM FANTASY AND SCIENCE FICTION: THIRD SERIES, edited by Anthony Boucher and J. Francis McComas. Doubleday & Co., Garden City. 1954. 252 pp. $3.25

There is better science fiction in other current magazines. There's better fantasy, too. But according to the fans, the best combination of the two —the nearest thing to *Unknown*, but with a flavor all its own—is *Fantasy and Science Fiction*. Here is the third fine selection from its pages. And for some obscure reason, Doubleday hasn't indicated anywhere on the spine of the jacket that this is Series Three. I've seen readers reach for it, then put it back with the impression they've already had it.

There are sixteen stories in this roundhouse roundup. They have been and will be getting into other people's anthologies too. Me—I'm not going to try to pick favorites: I'll just catalogue 'em for you.

The science-fiction label can legitimately go on nine out of the sixteen

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stories and for my money can also go on three more—including one "Gavagan's Bar" episode involving time peculiarly. The straight fantasies, to get them out of the way, are another of Manly Wade Wellman's unique tales of wandering John and his guitar ("Vandy, Vandy"), W. B. Ready's "Devlin" and Anthony Boucher's "Snulbug," both demon tales, and Richard Middleton's little ghost story, "Shepherd's Boy." On the fence: Philip José Farmer's anthropological gem, "Attitudes," the de Camp-Pratt "Untimely Toper," and Idris Seabright's "New Ritual" about a miraculous freezer.

In the science-fiction corner you will find such treasures as Ward Moore's inevitable "Lot;" Charles L. Harness' brand new twist in time travel, "Child By Chronos;" and Ann Warren Griffith's extrapolation to the time when we're all trapped in a "Captive Audience." (Did I say "no favorites"? Owell . . .) With them: an R. Bretnor comedy, "Maybe Just a Little One;" William Lindsay Gresham's "The Star Gypsies;" Kay Rogers' "Experiment;" P. M. Hubbard's item from *Punch;* "Manuscript Found in a Vacuum;" and the Cleanth Ransom misadventure, "The Maladjusted Classroom," by H. Nearing, Jr. Also, to close the book, an Alfred Bester science-fiction mystery, "Star Light, Star Bright."

These collections never let you down.

YEAR'S BEST SCIENCE FICTION NOVELS: 1954 edited by Everett F. Bleiler and T. E. Dikty. Frederick Fell, New York. 1954. 317 pp. $3.50

For some peculiar reason, the Bleiler-Dikty collections of short novels are by no means up to the very high standards of their annual short-story anthologies. This is doubly odd in that science fiction has traditionally been best when it had wordage in which to move around. Maybe that's no longer true.

These five long novelettes represent the kinds of science fiction currently popular, fairly well. "The Enormous Room," by H. L. Gold and Robert Krepps, from *Amazing Stories*, is an adventure in contrasts with an assortment of people trying to escape from a group of peculiar giants.

Kendall F. Crossen's "Assignment to Aldebaran" (*Thrilling Wonder*) is pure entertainment, with plenty of belly-humor in the manner in which Dr. Laertes Kwan Solomon, Professor of If-History at Solar University, outthieves the thievish folk of Aldebaran Three and makes them useful members of the Galactic League.

"The Oceans Are Wide," by Frank M. Robinson, from *Science Stories*, is the best of the five. As a starship nears the end of its generations-long voyage, the hereditary director finds that he must fight intrigue and prepare himself to carry out the even more vital duties of setting up a new colony on a second Earth.

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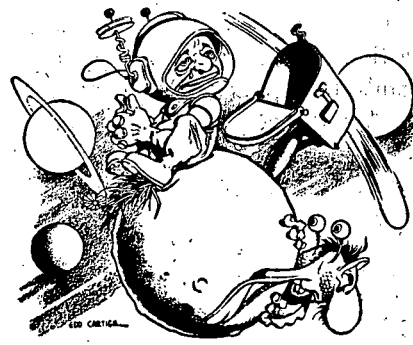
Murray Leinster, in "The Sentimentalists" (from *Galaxy*), has an amusing little item in which a couple of non-human honeymooners meddle with the affairs of a pair of human lovers and save them from villainy and catastrophe with the aid of a couple of twists of wire.

Finally, Philip K. Dick's "Second Variety" stands with the Robinson story as worthy of a Bleiler-Dikty rating. The typical Russian-Western future war has reached a stalemate as deadly robots, set loose as an automatic weapon, turn on all men.

SCIENCE AND SORCERY, compiled by Garret Ford. Fantasy Publishing Company, Inc., Los Angeles. 1953. 327 pp. $3.00

This anthology of stories, all but two of which (Ray Bradbury's now too-familiar "The Naming of Names" and John Martin Leahy's "Voices From the Cliff," from a 1925 *Weird Tales*) come from FPCI's former magazine, *Fantasy Book*, is pretty poor stuff by present-day standards. Even the poorest stories that get into the most ordinary current anthology show more story-craft than these.

Best of them: Alfred Coppel, Jr.'s wry little gimmick yarn, "What Goes Up" and Robert Gilbert's "Footprints." The rest would have been great stuff back in the early 1930's. Even I could sell stories then—of just about the same kind.



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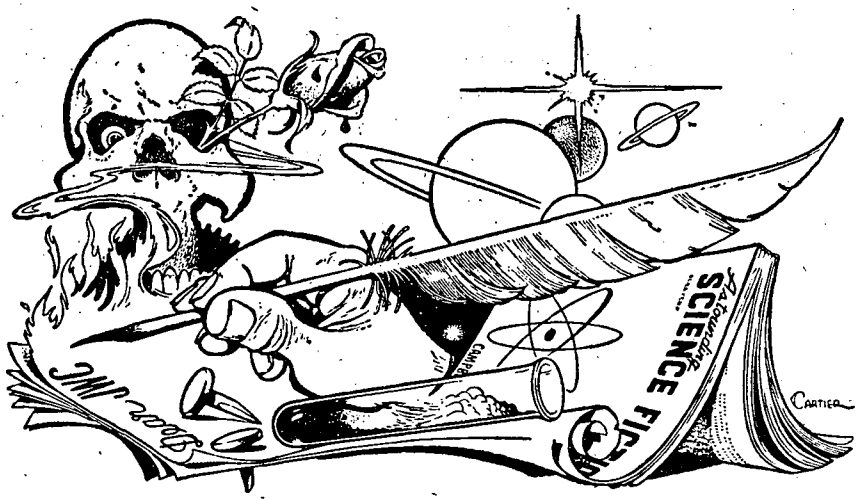

BRASS TACKS

Dear Mr. Campbell:

May I have a piece of this argument on the fascinating compound EDTA—one of the few chemicals I now claim to know anything about? Agreed with Mr. Segura—Calgon, citric acid, and some others are as effective as EDTA in removing radio-elements from surfaces. None the less, no one would dream of dosing people with Calgon or citric acid in the hope of washing radioactivity out of them: the former would be hydrolyzed, the latter metabolized before it could act. The virtue of EDTA lies in its own chemical stability and in the enormous physicochemical stability of its complexes with metals (say a billion times as great as those of Calgon)—enabling them to survive in conditions of acidity, alkalinity or temperature where most complexes totally break down. This is vitally important where hot effluents may have to traverse miles—or hundreds of miles—of pipeline in company with an unpredictable assortment of other chemicals before arriving at a safe dumping-point. But all this, of course, is only a facet of EDTA chemistry, which is opening a whole new world in analysis, chemical technology, and agriculture.—John H. Aiken, East Bungalow, Edge Lane, Entwistle, Bolton, Lancashire, England.

The day of the chelating agents is only just starting!

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Dear Sir:

Readers of Astounding Science Fiction will, I believe, be particularly interested in Professor George Wald's article, "The Origin of Life," which appears in the August, 1954 issue of *Scientific American*. This article should be something of a classic for us. It is an authoritative and clear summary of the things we know and the things we can assume about the origin of living organisms.

Professor Wald traces this process from the origin of organic compounds, and their accumulation and association, to the developments which permitted the new aggregations to gain energy for themselves with increased efficiency. He contends with the great obstacles to this process in two ways: by reference to the scale of time in which the origin of life occurred, and by showing how the changes in the Earth's atmosphere were related to the development of living matter.

The author reaches very positive conclusions about the origin of life elsewhere in the universe, which make his article all the more worth our attention.—Frank H. Tucker, Ph.D., 3614 Newark Street, N.W., Washington, D. C.

"Sci Am" has a number of articles well worth while—but what I like are the ads! Read 'em carefully, and you'll see they're offering robots for sale!

Dear Sir:

I have just received a copy of your January issue containing the so-called review of our book "America's Ancient Civilizations." As a review it is one of the best examples of Astounding Science Fiction—minus the Science I have seen in a long time. Who this man is I do not know. Neither do I know of his qualifications as an arbiter of archeological and ethnological matters. However, he has all the earmarks of a member of the American Museum of Natural History. The stand of the museum seems to be that anything not done by members of the museum staff or not published by the museum has no standing.

Not so long ago one member of the staff stated in his review that my table of the correlation of Maya dates was my own invention and drawn out of thin air. As a matter of fact, it was copied directly from the British Museum's report on the Maudslay collection of Mayan date inscriptions, plus a few very minor corrections suggested by Dr. Lewis Spence, former curator of the British Museum. Even the most embryonic student of archeology should have been familiar with this report and for a supposedly erudite scientist to state that these dates were my own invention, taken out of thin air, certainly shows the scientist's monumental ignorance of the subject.

Still another member of the staff criticizing my book refuted statements

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and reports made by members of the staff. If Mr. Miller is not an employee of the museum, and made marginal notes on the manuscript "Gods Who Were Men," as he states, he should be penalized for defacing museum property. In his so-called review, he first accuses me of being ignorant of modern methods of procedure stating that I did not make field notes and excavated merely to obtain showy specimens or objects of intrinsic value. He also states that my estimates of the age of Tiahuanacu are entirely wrong and that carbon tests proves that it does not date back more than about 2500 years. As a matter of fact no real Tiahuanacan cultural material has been tested, for the simple reason that none has ever been found, aside from a petrified human skull and fragments of early pottery. All material dated by the carbon tests was Incan material, relics of Incan occupation of that area. Mr. Miller then jumps to the Sumerian origin of the pre-Incan cultures. Incidentally, referring to the most ancient Peruvian culture as the pre-pottery people of the Pacific. Surely, even he could hardly consider primitive savages who had not learned to raise crops and make pottery as having a "culture."

As far as the Sumerians go he admits that the Sumerians may have had contacts with South America, but instead of going further and mentioning our various reasons for proving our point he suddenly turns his attention to my chapter on the Rio Cana culture of Panama. He claims I was still digging for spectacular or valuable specimens, knew nothing of modern methods of stratification excavation and hints I never found such a culture as I describe, as he has never seen any account of it in any scientific report. As a matter of fact, I am thoroughly familiar with stratification excavation having done a great deal of it elsewhere. Neither were I digging for attractive or striking objects of intrinsic value. As a matter of fact, among the thousands of specimens I obtained and which are now in the Museum of the American Indian, Heye Foundation, practically none, aside from the polychrome pottery, can be considered attractive, striking or of any intrinsic value. Moreover, the full report of the collection and my activity at Coclé may be seen at the Museum of the American Indian, Heye Foundation. I defy anybody to carry out stratification excavations at the Rio Cana site for as I mentioned in my chapter in the book, the place had been turned upside-down by terrific earthquakes so that any stratification that might have existed, had been turned topsy-turvy. In fact, in many instances the tops of monuments and heads of statues were many feet underground and below the bases of the monuments of which they had formerly been a part. Very evidently Mr. Miller has been basing his criticisms on Mr. Lathrop's reports on

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the graves excavated by him on the Rio Grande several miles distant.

However, the graves excavated by Mr. Lathrop had never been disturbed by earthquakes or otherwise and the stratification remained in almost the same position and same condition as when the burial had first been made. Surely, if ever there was a man who excavated for the sake of attractive specimens or objects of intrinsic value, it was Mr. Lathrop.

For long months after his excavations, periodicals were full of accounts of the wealth of the golden objects he had obtained from the graves and with scarcely a word in regard to the specimens of scientific or archeological value.

If our book is so farfetched and worthless, as Mr. Miller claims, it is most remarkable that a number of recognized archeological, anthropological and ethnological authorities should have found the book both valuable and interesting and should have been convinced of the soundness of our theories and conclusions. Among these are: Professor Clyde Keeler, Georgia State College for Women; Professor Henri Shetrone, professor at State College of Ohio; Dr. Daniel F. Rubin de la Borbolla, director of the Museo Nacional, Mexico; D. F., Dr. Lewis Spence, former curator in department of archeology, British Museum and others.

I think Mr. Miller should confine himself to writing reviews of scientific fiction for publications. For when he plunges into the controversial sea of archeology and ethnology, and the origins of America's early, higher cultures he dives far beyond his depth and only betrays his ignorance of the subject.

I do not feel that his long, involved and often contradictory dissertation on our book is in any way harmful or will affect its sale. The general public have become so accustomed to blowhards letting off steam by criticizing books that do not appeal to them personally, or agree with their point of view, that the buying public take all such reviews with a grain of salt. In fact, in a great many cases an unfavorable review of the book will add to its sale as the public wishes to see for itself what the proof of the matter may be. In fact, one reviewer who knocked our book in one of the leading papers wrote to me, that despite the criticism he had recommended the book to a group of college professors and suggested that it should be used as a textbook!

Personally I pay practically no attention to this type of review and feel that one favorable opinion from a qualified judge of the subject more than offsets a dozen unfavorable reviews by men and women who know nothing about the subject.—A. Hyatt Verrill, Chiefland, Florida.

Dear John:

I do want to comment on A. Hyatt

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Verrill's objections, the more so since I owe him one apology. Had I gone on to read the bibliography of the "Handbook of South American Indians," or had there been a file of the Heye Museum's "Indian Notes and Monographs" anywhere in Pittsburgh, that I could or can find, I would have known that he published a short report on his work at Coclé in Panama, and on work in British Guiana among other places. I had confused a reference to the 1927 Coclé report, made in passing by Lothrop in his chapter on Panama, with Verrill's 1927 book, "The American Indian"—and he does not, probably through modesty, list his own report in his own bibliography.

This work, which was evidently a pioneering effort, has been inexcusably neglected by the later professional writers: only Doris Stone, of the "Handbook" contributors, mentions Verrill by name. I have no use for this kind of professional snobbery, and said so in the review.

As for myself, I have never visited the countries of which Mr. Verrill writes, let alone worked there as an archeologist. I have been reading on archeology for the last twenty years—spurred on, as a matter of fact, by Verrill's own articles and stories in my school and college days—have done field work here in the Northeast with a couple of museums and with other amateurs in the New York State Archeological Association, and am for my sins currently president of the Society for Pennsylvania Archeology—which implies only a willingness to preside at meetings. I am not, needless to say, on the staff of the American Museum of Natural History and have not read or vandalized Mrs. Verrill's manuscript there. If the book is published—and it certainly should be if Colonel Churchward's vaporings about Mu can stay in print and Velikovsky become a best-seller—I will then do what I tried to do with "America's Ancient Civilizations"; show how it compares with "orthodox" views on the same subject, if I can find out what they are.

I do very definitely consider that primitive savages of whatever level have "culture," which to me has nothing to do with a college education or a taste for music, art, literature and a family tree antedating the Mayflower (best I can do is 1630). Like most modern archeologists, I look on culture as—to quote Dr. William Howells in "Back of History"—"all the inventions, and all the conventions, ever made by humanity."

Now to specifics. To say that Tiahuanaco culture cannot be dated by the radiocarbon method because no remains of the Tiahuanaco culture have ever been found, is to me like saying that "Hamlet" wasn't written by Shakespeare because none of Shakespeare's plays have ever been found. If Mr. Verrill means some other culture than the one which produced the famous gateway and other stone

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ruins at Tiahuanaco, which nobody but he and Posnansky have seen, then maybe *his* Tiahuanaco culture is 14,600 years old. But both he and Posnansky—whose book I have seen, but don't have here—show the same ruins and carvings which "orthodox" archeologists, using orthodox methods, place some thousands of years later.

If specimens from Tiahuanaco itself have been dated by radiocarbon, the results have not been published in any journal I have seen. I got my 2500-year-old estimate indirectly, in the same way that any archeologist does, based on the assumption that implements and art-objects—ceramics, textiles, et cetera—of the same specialized kinds were used more or less simultaneously by the same people or people in contact with each other, and not by people thousands of years apart. Now the Tiahuanaco culture, in the orthodox view, was the first great pan-Andean culture, spreading its empire from the altiplano of Titicaca to the north and south coastal valleys—and there it did replace earlier, well-advanced cultures whose remains *have* been carbon-dated.

James Ford's article in the August *Scientific American* gives an up-to-date summary of what was found in the Viru Valley of northern Peru. The Tiahuanaco expansion, in its "Classic" stage—thought to be responsible for the ruins at Tiahuanaco itself—put an end to the also spectacular older Mochica culture, itself only one of a

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series of advanced cultures in the Viru area. Ford estimates that this did not take place until about 1000 A.D. I got my estimate of 2500 years for the *beginnings* of the Tiahuanaco culture by accepting such cross-dating as you find in the chronological chart on page 112 of "Andean Culture History," by the late Wendell C. Bennett and Junius B. Bird, both of the Museum of Natural History. In 1949, before Carbon 14 dating, they placed the beginnings of Early Tiahuanaco in the South Highlands (Titicaca) as contemporary with the Gallinazo culture in the North—and a Gallinazo sample was dated 2474 ± 141 years old; one from the (South Coast) Paracas Necropolis, of the same general period archeologically, was 2257 ± 200 years old.

To say that all these samples, which competent archeologists have taken from excavations made within the last fifteen years, are "Incan material" is simply to throw out the entire body of recent archeological work as incompetent or falsified. I won't do that.

The Verrills accept Posnansky's estimate of the age of the Tiahuanaco ruins, or of something at Tiahuanaco —what he shows in his book are the same ruins they illustrate. As I said, I don't have his work here, but he seems to reach the same dates by the same arguments as one H. S. Bellamy, author of "Moons, Myths and Man." Bellamy says point-blank that his 14,000-year age for Tiahuanaco is based on the rather dubious Hoerbiger "Cosmic Ice" theory—for which I refer you to Sprague de Camp's "Lost Continents," pages 86–89 et al—and on the assumption that the ruins were raised intact some thousands of feet from sea level to the present Bolivian plateau, by Hoerbiger's cataclysm.

As for Coclé, I agree that Samuel Lothrop does not seem to give proper credit to Verrill's work in his "Handbook" article—I don't know what he does in his full scientific reports, since I don't have them here in Pittsburgh. Undoubtedly the newspapers and popular magazines played up only the spectacular side of his finds: they always do, and so do museum directors, which is the reason for trying to base your judgment of excavations on the original specimens, or at least on the digger's scientific reports, rather than someone else's version of what he found. Human nature likes the colorful and spectacular, which is one reason why Mr. Verrill's books have sold so well. More museums than not are still looking for spectacular sculptures, temples, treasure-troves and the like rather than digging rubbish-heaps like us North Americans—and it is not only extremely difficult to get sound stratigraphic information from the graves in a large cemetery, but from excavating the ruins of towns where the remains of structures used at the same time may be at many different physical levels.

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digging I was talking about—call it the Midwestern school, if you like, from the Universities of Chicago and Indiana, where it's taught—is the literal dissection of a midden or rubbish heap, a few inches at a time, recording every detail of structure and the depth of every artifact and feature. It may be quite true that in Middle and South America and the Middle East, especially with limited time and funds and native laborers, this isn't practical or possible. But it's the kind of digging you can trust.

I don't know the reasoning behind the Verrills' Sumerian theories, since they are set forth as established in this book. I have found what look like the same or similar conclusions in a book by one Colonel L. A. Waddell, "The British Edda," subtitled "the exploits of King Thor, Arthur or Adam and his knights in establishing civilization, reforming Eden and capturing the Holy Grail about 3380–3350 B.C." The full explanation of Waddell's theories, which he says prove conventional ideas of Egyptian and Mesopotamian history to be "merely fanciful conjectures," is in his book "Makers of Civilization in Race and History," which I can't find here in Pittsburgh.

Waddell makes the same general statements about Sargon, Menes and the Sumerians as the Verrills, but apparently does not carry them to Peru. On the other hand, the Verrills don't seem to have adopted the Englishman's "Aryan supermen" attitude —his Sumerians are Goths, and apparently all languages are basically Aryan, no matter what the stupid linguists think.

As to what "The Reference Library" should and should not review, I'm afraid I'll have to follow my own lights, in line with the policies you and the publishers establish. Anything you don't like, you can throw out. If I'm unbearable, throw me out. But when

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a book of science comes along, dealing with a field which is important in science fiction (lost races, astronomy, telepathy—time travel, if it ever comes), I think it should be noticed, especially when it comes up with a completely new and unorthodox theory.

If A. Hyatt Verrill claimed to have found a Sumerian clay tablet, which he had had translated by an expert in Sumerian such as Dr. Noah Kramer at the University of Pennsylvania, in place in a Coclé grave or a Maya pyramid, I'd be inclined to believe him. I'll go right on recommending many of his books, such as his new "The Real Americans"—though there are traces of the Sumerian theory, and other minor inaccuracies in it. But I just don't see convincing evidence in "America's Ancient Civilizations" that all the work of men like Bennett, Bird, Kroeber, Strong, Tschopik, Tello and Larco Hoyle is naive nonsense.—P. Schuyler Miller, 4805 Centre Avenue, Pittsburgh 13, Pennsylvania.

I don't know. You two settle it.

Dear Mr. Campbell:

This is one of those I-have-never-written-to-a-magazine-editor-before letters, but having gotten that off my chest, we can drop it.

I want to thank you for the editorial this month; it clears up a lot of historical points that have always seemed a little bit vague to me. And, too, it points up something that very few people seem to recognize: Engineering is *not* science.

If the engineer can and will use the products of science, fine and dandy, but science, *per se*, is not necessary for engineering. Science is a methodology for discovering rules that work. Engineering is a process of applying rules that work. But those rules do not have to be the product of the scientific method!

The engineers of ancient Egypt knew a rule that worked very well. Simply stated, it is that a piece of string divided into three parts in a ratio of 3–4–5 and staked out into a triangle at these points will give you a right angle at the point where the 3–4 sides come together. It was a rule that worked, and the engineers applied it, and others like it, to building pyramids and temples that were perfectly beautiful pieces of engineering.

But not one of those rules was discovered by the scientific method!

Even today, science is not absolutely necessary to an engineer—I'm an engineer, so I know. Give a competent engineer the rules he must apply—tensile strengths, moduli of elasticities, distances, load limits, and the mathematical rules that go with them—and he can build you a bridge. Granted, most of these rules today come from scientific research, but they didn't *have* to. The engineer

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doesn't give a good round damn where they come from, as long as they *work!* Or, at least, he shouldn't.

I don't say that an engineer and a scientist can't be combined in the same man; they often are. And quite often, a piccolo player is a good composer. But the ability to compose is not necessary to play the piccolo.

The stories this month are all good, but the most outstanding, to my way of thinking, is "The Hunting Lodge," by Randall Garrett. It was a logical story, logically worked out, and it shows very neatly the limitations of a machine. The background added a great deal to the story, and still leaves a little itch in the back of my prefrontal lobes. This is the first story in a long time that really cries for a sequel. What about more extrapolation on that background, Mr. Garrett? You still have four more senators to kill, and I'll bet they get harder to kill as you go along.

Second place goes to the article "Achilles and the Tortoise" oddly enough. I think I see where he's headed, and if he's going where I think he is, the interstellar drive may come sooner than we think.

Third place, "Pyramid." At first, this reminded me of the rabbits in Australia, but after a while I realized it was a case of wolves in the sheep pen.

I really hate to give Poul Anderson's "Question and Answer" fourth place, because I usually like Mr. Anderson's writing. But this time he just didn't quite come up to par. Perhaps it's because his explanation of the problem isn't quite as appealing to me as Isaac Azimov's was.

In a quarrel over fifth and sixth places are "The Disturber" and "In The Beginning." Both entertaining, but not outstanding.

Keep up the good work; you're still running the best magazine in the field.—Leroy Davidson, 2901 Western Avenue, Peoria, Illinois.

We won't run the multiple-stories-on-the-same-locale scheme again. Reason: The second man is up against the reaction "But I've heard this before—" to an unfair extent.

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Continued from page 6

fectly true he could score a far higher percentage of accuracy on his prognoses — over a long span of years — than could the physician who makes individual diagnoses.

Another trouble with statistical methods is that they cannot work well in any situation concealing a crucial point. To heat water from 270° Kelvin to 280° Kelvin takes about 80 calories. This means that it takes 8 calories to heat water 1° Kelvin? No, because 273° happens to be the crucial point where water melts; if your statistics conceal this fact, you'll get some peculiar conclusions.

Another type of crucial situation is that which might be exemplified by the proposition: "It has been statistically proven that 99.99% of the individuals in this critical secret laboratory are trustworthy. This means that only 0.01% of the critical information can be expected to leak out."

Obviously, statistical generalizations are utterly futile in such situations; the intuitive-type generalization which would permit analysis of individual cases is necessary. The psychologist, with his statistical correlations, is helpless to determine the nature of any individual; the psychiatrist can do somewhat better, but obviously leaves much to be desired.

If the psychiatrist *could* determine the stability of an individual, there would be no security problem in our major laboratories — and no instances of psychotics, released from institutions, going happily home and murdering their families.

Statistics are highly useful — but they are, and always will be, crutches substituting for real understanding. The medical profession can well be proud of their work on diabetes — provided they remain dissatisfied with the situation. The highly ingenious prosthetic devices supplied amputees well merit praise and appreciation — but they are not to be considered reason for abandoning efforts to induce regeneration of human tissues.

And any scientist who considers that a statistical technique is "the only proper approach" to a problem should be quietly by-passed by someone willing to tackle the tougher job of achieving real understanding. This applies equally to the quantum physicist, and the social scientist. The professional gambler has more sense than that; he doesn't rely on the statistics of dice-throwing; he takes the effort to practice until he can throw the number he wants, using honest dice.

Any group that holds that only statistical generalizations are respectable is inherently, and basically wrong. There is a need for crutches and prostheses — but there must be some natural, operating parts somewhere to control those crutches. You can't build the structure entirely of prosthetic devices!

THE EDITOR.

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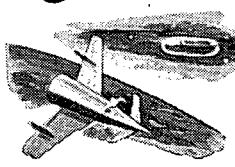

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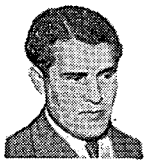

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